SCIENTIFIC AMERICAN

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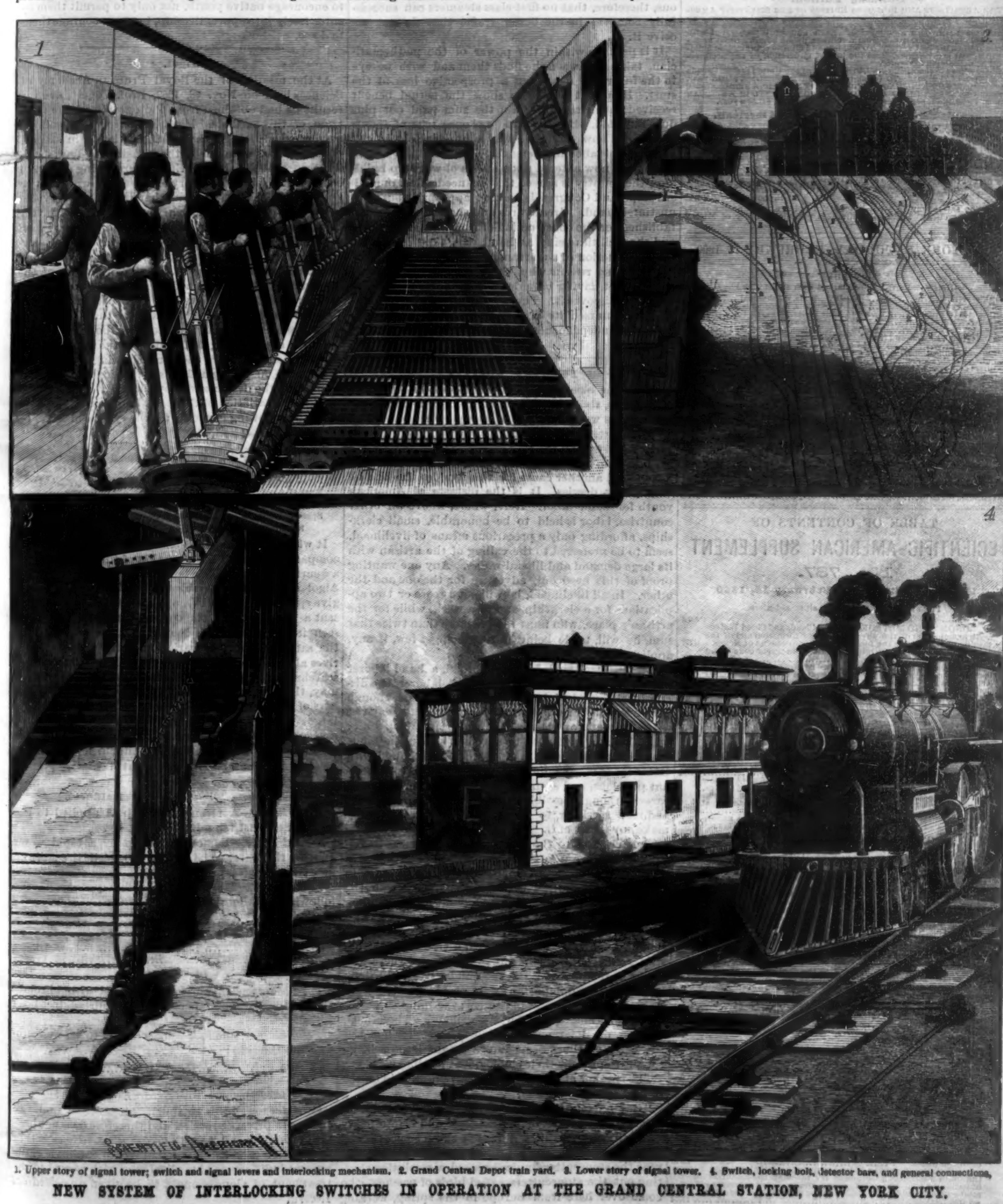
THE MECHANICAL INTERLOCKING SWITCH AND SIGNAL SYSTEM AT THE GRAND CENTRAL DEPOT, NEW YORK.

The yard of the Grand Central Depot, in New York, has recently been equipped with a new interlocking switch and signal system. Four parallel lines of tracks enter the yard at its northern end, and as they approach the two depot buildings fork and diverge until twenty-one lines of parallel tracks are produced. Trains from three separate railroads enter and leave the depot, involving between two and three thousand train movements daily.

The general principle of interlocking switch and signal mechanism may be given in a few words. In a central building called the tower a number of levers are placed. These are connected to rods running along the tracks, some for operating switches, others for rotating signals. When a lever is pulled in one direction or the other, it therefore moves the corresponding switch or lever. The levers are made to interlock with each other, so that certain levers can only be moved after others have

(*Continued on page* 102.)



1. Upper story of signal tower; switch and signal levers and interlocking mechanism. 2. Grand Central Depot train yard. 3. Lower story of signal tower. 4. Switch, locking bolt, detector bars, and general connections.

NEW SYSTEM OF INTERLOCKING SWITCHES IN OPERATION AT THE GRAND CENTRAL STATION, NEW YORK CITY.

Scientific American.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 737.

For the Week Ending February 15, 1890.

Price 10 cents. For sale by all newsdealers.

HELPING THE MERCHANT FLEET.

The plan outlined in the bill recently introduced into Congress by Mr. Cummings, of New York, for dealing liberally with American steamer lines in the matter of mail contracts, would seem to have much to commend it and to be worthy of a trial. The bill does not contemplate the payment of subsidies save in the way of recompense for carrying the mail, nor is the rate it fixes in excess of that we now pay foreign lines for the same service. The remittance of dues and charges and similar favors seems not too much to ask; the loss of revenue fancied rather than real, for if there were to be such imposts there would not be any ships, and hence no source for such a revenue.

All that is asked may fairly be regarded as insignificant if it will enable ships which cost more to build and more to man than foreign ships to keep the seas.

The class of subsidy, if payment for service actually performed can rightly be called a subsidy, which it is designed to pay these steamers is one generally prevailing now upon the ocean, and it is immediately obvious, therefore, that no first-class steamers can successfully compete in the ocean traffic that do not receive it.

It is perhaps within the power of the mathematician, taking things as he finds them and with no eye to the future, to figure out a prospective loss at the start. He might be able to show the actual benefit received much smaller than the sum paid out plus dues remitted. But the same was once true of industries which now pay their way a hundredfold in employment of labor and demand for material.

We have now entered upon an era of war ship building; the country is agreed that we need a fleet of modern ships, and Congress is making appropriations with unstinted hand. Great yards and shops are being established for the construction of iron and steel ships, and the facilities being at hand, the time is ripe for the construction of a mercantile as well as a war fleet.

There is no reason why, the most efficient type of ship not yet having been decided upon, we should not ourselves discover it. There is no reason why a nation which has nursed its land industries into a state of profitable independence should be less liberal with its shipping.

EUROPEAN WORKERS.

One of the speakers before the National Association of Builders, recently meeting at St. Paul, declared that less persons were learning trades to-day than 25 years ago. He attributed this to the restriction of the apprentice system by the trade unions.

Those who keep themselves informed will, however, have found another cause for this besides the one he very justly decries. It is the distaste of American youth for hand labor. Here, where, above all other countries, labor is held to be honorable, small clerkships, affording only a precarious means of livelihood, seem to be preferred to the calling of the artisan with its large demand and liberal wages. Any one wanting proof of this need only advertise for the one and the other. In all likelihood, he will get a score or two applications for a clerkship at $10 a week, while for the artisan's place, who must receive more than twice that sum, he will, trade being fairly good, get few, if any, applications.

If it were true that here, as abroad, a hand laborer was likely always to remain a hand laborer, the discrimination might be more easily understood, though perhaps equally senseless. But a man here may rise as quickly and as high as his fortune and capability will take him, with none to ask him whence he came. The workshops and mills of the country abound with instances of men coming up from the ranks to important positions, and even to be owners of works. Such careers, though possible anywhere, are frequent here, and men so rising, to their credit be it said, rarely make any secret of it.

The delegates to the all-Americas Congress, traveling through the West, were entertained one evening in a palatial residence. Its owner, who, we may say in passing, is the largest carriage manufacturer in the world, called their attention to a painting, hung upon the wall, of a humble village smithy. "There," said he, "I began my career." What with the disinclination of American youth to learn a trade and the obstacles the trade unions put in the way of those who might be tempted to do so, the builder has now to look to Europe for an important part of his working force—the stonecutters and plasterers; the number native here being inadequate for the demand. These men, it seems, do not remain, taking steamers for home at the close of the season, and a means is now being sought to prevent their employment at all.

The speaker at the Builders' Convention said on the subject:

"Cut off our foreign mechanics to-day and not increase the number of apprentices, and before many years the nation will be robbed of the means of material advancement. As a proof of this, within the last year the stonecutters' unions passed a resolution shutting out the stonecutters called birds of passage, who come over here from Europe in the spring, working here all summer and autumn for good wages, and when the winter sets in go back to their homes, taking the money they have saved with them to be left on the other side, and repeat the same thing year after year; and as a consequence of shutting out so large a number there is a great scarcity of good stonecutters in our large cities and the progress of building greatly delayed. With this policy of the unions I am in full sympathy, if at the same time they will remove restrictions placed on the industrial education of our youth. The plasterers are now very largely dependent upon the foreign supply, and becoming so scarce that in the busy season they can demand almost any wages. This, certainly, is not a healthy state of things for the nation and people when we cannot either educate mechanics or import them."

The reason that these foreign stonecutters and plasterers come here is, of course, because of higher wages, and the measure resolved upon by the unions, instead of keeping them out, is calculated rather to force them to remain here. It would seem, therefore, a wiser policy to encourage native youth, not only to permit them to enter freely into apprenticeship, but to encourage them to do so.

Algol.

At the meeting of the Royal Prussian Academy of Sciences held on Nov. 28, 1889, Prof. Vogel gave the results he had obtained from photographs of the spectrum of this variable. Prof. Pickering had pointed out, some years ago, that if the variation in stars of the Algol class were due to the transit of a dark satellite across the disk of its primary, producing a partial eclipse, then, since in every case yet known the two bodies must be close to each other and of not very disproportionate size, the primary must revolve with very considerable rapidity in an orbit round the common center of gravity of the two, and, therefore, be sometimes approaching the earth with great rapidity and sometimes receding from it. Six photographs of the spectrum of Algol—obtained, three during last winter, and three during the November just past—have shown that before the minimum the lines of the spectrum of Algol are markedly displaced toward the red, showing a motion of recession; but that after the minimum the displacement is toward the blue, showing a motion of approach. Assuming a circular orbit for the star, and combining the details given by the spectroscope with the known variation of the star's light, Prof. Vogel derives the following elements for the system of Algol:

Diameter of Algol	1,074,100 English miles.
Diameter of the dark companion	840,000 " "
Distance of center	3,269,000 " "
Speed of Algol in its orbit	27 miles per second.
Speed of the companion in its orbit	56 " "
Mass of Algol	4/9 of the sun.
Mass of the companion	2/9 " "
Speed of translation of the entire system toward the earth	2 miles per second.

It will be seen that the density, both of Algol and its companion, is much less than that of the sun—less than a quarter, in fact. This is what we might expect, for Algol and all the variables of its class yet examined give spectra of Group IV., and should therefore represent a less advanced stage of condensation than that seen in our sun. This demonstration of the truth of the satellite theory of variation of the Algol type derives also an especial interest from Prof. Darwin's researches on tidal evolution, for assuming, as we well may, that the cause of variation is the same in all members of the class, we now know of nine stars in which a large companion is revolving round its primary at but a very short distance from it and in a very short space of time. The companion of U Ophiuchi must, indeed, be almost in contact with its parent star.

Lassar's Treatment for Baldness.

First Stage.—A strong tar soap is applied to the scalp for at least ten minutes.

Second Stage.—Removal of soap by a tepid water douche, the water to be gradually cooled, the scalp to be well dried afterward.

Third Stage.—The scalp to be shampooed with the following solution:

℞. Hydrarg. bichlorid. corrosiv........ gr. x.
Glycerin,
Spirit. rect........ aa ℥ij.
Aq. destil........ ℥v.
F. fiat solutio. S.: For ext. use.

Fourth Stage.—Shampooing of head with absolute alcohol to which half per cent of naphthol has been added.

Fifth Stage.—The following solution to be well rubbed into the skin:

℞. Acid. salicyl........ gr. xxx.
Tinct. benzoic........ ʒj.
Ol. ped. taur........ ad ℥iij.

Graetzer found this treatment most useful and efficacious in private practice, and therefore does not hesitate to recommend it to the profession. He says that with such a powerful method of treatment in view, the present indifference of medical men with regard to the treatment of alopecy ought to be given up.—*Medical Record.*

Antiquities Made to Order.

The rage for having furniture of the antique pattern has grown wonderfully during the last few years. Antique oak dining suites, bedroom suites, and hall furniture seem to be the most popular, but anything of an antique character now sells rapidly. Many purchasers who are furnishing their houses really believe that they are buying furniture which some old time Puritan had used. In this they are greatly mistaken. Antique articles are manufactured every day in the different warehouses.

A furniture dealer was recently interviewed by a New York *Mail* reporter on this subject. He said: "A few years ago agents used to be sent all through the rural parts of New England to pick up superannuated furniture of every kind—such as was found astray in farm houses, village attics, country hotels and elsewhere, having been handed down from generation to generation in the families of long-resident natives. The latter were usually willing enough to part with the treasures, which were only valuable in the eyes of people of æsthetic tastes, and the dealer paid a mere song for the articles, reaping a big profit. But now the supply obtained in this way has been practically exhausted. Now it is the fashion for rich Yankee people to have in their houses one or two apartments in the old colonial style, with floor and walls of dark oak, massive rafters, huge fireplace, mahogany furniture, and an occasional spinning wheel. There are not nearly enough of these precious relics to go around, so it is a blessing that provision is made for reproducing them indefinitely at comparatively cheap rates.

"The most approved method of giving a floor or wall a look of old age is to scrub it at intervals with gallons of old ale. This produces a fine effect. Mahogany is generally used for the manufacture of antique pieces of furniture. In its natural state it is no darker than black walnut, and to make it of the proper hue staining must be resorted to. If oak is wanted, it is rubbed with common shoe blacking, and the usual wax finish put on afterward. This is warranted to add fifty years to the apparent history of a bureau or desk in one hour. For the inside works of said desk or bureau pine is employed, and this is given the requisite look of antiquity by repeatedly firing a shotgun loaded with nothing but powder, and plenty of it, into the drawers and around them until the surfaces exposed are sufficiently discolored and all full of those curious indentations which ordinarily indicate age. Another process is to wash the drawers, etc., with a coarse sponge dipped in powerful acid, which eats wood here and there, and effects the same result.

"Brass fittings are manufactured in all the ancient designs that were ever used. In order to make them look dull and old, the moulds in which the brass is cast are rubbed and chipped somewhat, and in them a little gunpowder is placed and fired with a match. This occasions a discoloration, which seems to betoken the action of time's gnawing teeth, and the same is warranted to last until the merchandise is sold, though not much longer.

"A special branch of the work has to do with clocks of the ancient upright pattern, which are copied in every detail from the really old ones. Even the metal faces, with their curious numerals, are imitated, and the works of modern pattern are permitted to lie in a dusty corner and oxidize comfortably while the framework is in process of construction. There is nothing, the makers say, in the line of back number furniture that cannot be reproduced at a few days' notice from brand new materials, and yet so like the old that no ordinary person could possibly tell the difference."

A New Drier.

M. John Castelar, in the *Moniteur des Produits Chimiques*, has drawn attention to the valuable properties possessed by manganese oxalate as a drier. This salt has hitherto not had any important industrial uses; but as it can be readily prepared in a state of purity from the native carbonate by the action of oxalic acid, the author is of opinion that it will be found of use for this purpose. If prepared from carbonate free from iron and lime, it can be obtained as a fine crystalline white powder, and 2·5 per cent is sufficient to bring about the change. The oxalate is resolved by heat into manganese oxide, carbonic acid, and carbon monoxide, and in the presence of fatty acids the manganese oxide formed combines with them, the decomposition taking place at about 130 deg. The operation is easily carried out by mixing in a mortar the oxalate with two or three times its weight of oil, and then adding the mixture to the main portion of the oil. The heat should be applied gradually, and the decomposition is known to be complete when there is no further evolution of gas. The boiled oil, under this treatment, preserves its limpidity, and also remains colorless. Manganese oxalate has the advantage over oxide of lead, which is commonly employed for this purpose, in causing the oil to remain transparent when exposed to sulphur vapors. Manganese acetate has also been used, but it likewise causes a darkening in the color of the oil, and the nitrate is dangerous, owing to the possible action of nitric acid on the fats present in the oil. Manganese borate appears to be next in value to the oxalate as an oil drier.

English and German Torpedo Boats.

The embodiment in designs of the various opinions held by builders with regard to form of hull in relation to power and speed produces marked differences in the expenditure of power and general efficiency, when the object aimed at is the same. British builders, as a rule, adopt comparatively full bow lines, with sections more or less of the U-form. In many French-built boats the water lines at the extremities are comparatively full, with a midship section approaching in contour that of the old Symondite type of British naval brig. German builders, on the other hand, seem to believe in extreme fineness of entrance, and to secure this feature have in the majority of cases placed the greatest section abaft the middle of the length, giving to the boat a long fore body, with a relatively full after body. The adoption of such a form tends to reduce the proportions of the bow wave created when running, and to remove the crest further aft along the side, but against this crew space is reduced and comfort at sea sacrificed. The difference in fullness between the fore and after bodies is greatly exaggerated when the boat is running, as an alteration of trim then takes place, the bow rising above and the stern falling below the original level. In relation to resistance, the policy of adopting an after body full in relation to the fore body is a doubtful one. Mr. Froude—than whom no better authority can be quoted—has distinctly stated that fish-shaped bodies, towed with the blunt end foremost, experience a less resistance than when towed from the fine end. Applying this statement to the type of vessel under consideration, then those which attain extreme speeds, with relatively full runs, do so with an undue expenditure of power; and it has also been proved that excessive fineness of fore body is not a desirable quality at sea.—*Industries.*

TABLE GIVING PARTICULARS OF TYPICAL ENGLISH AND GERMAN TORPEDO BOATS.

Builder	Thornycroft	Yarrow	Yarrow	Schichau	Schichau	Germania Company, Kiel
Government built for	Spanish	Spanish	Italian	Chinese	Italian	Ottoman
Date	1887	1887	1887	1886	1888	1887
Name of boat	Ariete	Azor	—	—	Nibbio	—
Length	147 ft. 6 in.	135 ft.	140 ft.	144 ft. 4 in.	152 ft. 8 in.	196 ft.
Breadth	14 ft. 6 in.	14 ft.	14 ft.	16 ft. 5 in.	17 ft.	19 ft. 5 in.
Draught	5 ft.	—	—	7 ft. 6⅝ in.	7 ft. 6 in.	—
I. H. P.	1,550	1,500	—	1,097	2,200	1,250
Speed in knots	26·008 (mean of 6 runs)	24·0 (mean speed during 2·75 hours' run)	25·101 (mean of 6 runs)	24·25 (mean of 1 hour's trial)	26·0	21·5

How to Make Matt-surfaced Glass.

Matt-surfaced glass, in which the roughening is very fine, has several uses in photography, and by the etching method as given in detail by Lainer a surface can be obtained in which the graining is very much finer than can be produced by grinding, and for such fine focusing screens as are required in special scientific work there is considerable advantage in using the etched glass surfaces.

Lainer's method of operating is as follows: The glass is first cleaned with the same care as is required in preparing a plate for the wet collodion process, after which it is bordered with wax, and when set on a leveling stand the plate is flooded with dilute hydrofluoric acid, made by mixing one part of the commercial acid with ten of water, this acid being allowed to remain on the plate for about a minute. The object of this preliminary etching is to produce an absolutely clean surface. The acid is now rinsed off, and the plate is wiped with a soft and carefully cleaned sponge.

The plate is next leveled, and the matt etching preparation is poured on. This etching preparation is made as follows: In a suitable vessel—wood lined with asphalt is recommended—is poured enough strong hydrofluoric acid to fill it not more than one-fifth full, and powdered crystals of sodium carbonate are gradually stirred in until the mixture becomes thickish and hangs like snow on the stirrer, which stirrer may be a strip of wood soaked in shellac varnish and dried. The white foaming mass is at this stage strongly acid. It is advisable to perform the operation of partial neutralization out of doors, not only on account of the irritating nature of the fumes (carbon dioxide saturated with hydrofluoric acid), but also on account of possible damage to lenses or other polished glass surfaces.

The pasty mass of fluoride of sodium and hydrofluoric acid is now diluted with water, from five to ten times its volume being required, according to the degree of concentration of the original acid. The best way is to begin with the smaller proportion of water, and to etch a trial piece of glass by leaving the liquid in contact with it for two hours. If the etching gives a very close, fine grain all is right, but if, on the other hand, the grain is coarse, unequal, and almost crystalline in appearance, further dilution is required.

When the dilute preparation is so weakened by use that it acts too slowly, a little more of the pasty soda mixture may be added. In etching the plate, cleaned as already described, a layer of liquid from a quarter to half an inch deep is required. When the etching is complete the plate is rinsed and scrubbed with a hard brush to remove an adhering film of decomposition products.—*Photo. Review.*

A Large Phosphor Bronze Casting.

A few days since, at the Gateshead works of John Abbot & Co., limited, another very heavy casting of phosphor bronze was successfully made. It is one of a series for the new British cruisers now building at the Elswick works of Sir W. G. Armstrong, Mitchell & Co. Two very heavy castings have already been made, as previously pointed out in the Newcastle *Daily Chronicle*, and these were the earliest so cast in England. To John Abbot & Co., limited, the casting of a nine ton casting in iron is a small event, for "bed plates" for engines are in brisk times often cast far exceeding that weight, but the novelty of the metal and weight of its casting drew foremen and apprentices from several departments of the works to witness it. Alike by the young apprentice, with his moulding tool by his side, and the experienced foreman, the tapping of the reverberatory furnace, the running of the orange hued metal into a huge ladle, the conveyance by an overhead traveling crane to the ladle wagon, and thence to the mould, were witnessed with great interest, as well as the filling of the mould from the ladle, until a burst of flame from the air holes indicated the completion of the work. The phosphor bronze—an alloy of copper and phosphorized tin giving a metal of great tenacity and strength—run into the ladle from the furnace, was about nine tons in weight, and the value of the metal was stated to be nearly $9,000, the casting itself being less in weight, and cast in a sand mould. One of the other castings, made a few days ago, was shown in the yard, and was a magnificent piece of work.

An Electric Snow Sweeper.

The electrically driven snow sweeper in use on the West End Street Railway in Boston consists of a platform car, mounted on a four-wheel truck, two Thomson-Houston motors of 15 horse power each being attached to the axles. Underneath each end of the car is a large cylindrical brush made of rattan, set at an angle of about 45 degrees, and reaching across the track. The brushes are revolved very rapidly by power from a fifteen horse power electric motor which is on the platform of the car. The sweepers are propelled precisely the same as the electric cars, the long pole reaching the trolley wire being fixed to a post on the platform.

A COMBINED COTTON CHOPPER AND CULTIVATOR.

The accompanying illustration represents a combination implement which has been patented by Mr. Perry L. Jordan, of Garvin, Texas. To the inner face of each drive wheel, the wheels being mounted loosely on the axle, a sleeve is rigidly attached, and on the inner end of one of these sleeves a spur wheel is secured. Upon the reach bar a sleeve is also held to revolve, having integral therewith a pinion adapted to mesh with the teeth of the spur gear. From opposite sides of this

JORDAN'S COTTON CHOPPER AND CULTIVATOR.

sleeve upon the reach bar project two or more arms, to which rods are adjustably secured, adapted to carry scraper blades on their outer ends, a scraper blade being provided for each set of arms, and the cutting edges of the blades facing in opposite directions. The scraper blades have a slight inward inclination, and may be adjusted farther out or closer to the sleeve, as required by the width of the row. Two cultivator stocks are attached when the implement is to be used as a cultivator and scraper, these stocks having each at their forward end a hook adapted to embrace a squared central portion of the axle, and the stocks having each a downwardly extending section, to which the cultivator shovel is attached. To prevent the driving reins from catching in the scraper arms, two vertical rein holders are provided, extending upward from the central portion of the axle. The cultivator blades are guided by the operator as the machine is driven forward, and this attachment may be readily removed when not needed.

AN IMPROVED HAND RAKE.

The accompanying illustration represents a rake which is light, strong, and durable, and designed to supersede the old-fashioned wooden rake. The head of the rake is preferably made of a flat plate of No. 16 sheet steel, having its lower edge bent outwardly at right angles, and in this edge are slots or apertures, through which the upper ends of the rake teeth are in-

PAXSON'S HAND RAKE.

serted, to bear laterally against the flat-head plate, the top of each tooth being bent inwardly at right angles through a slot or aperture in the vertical part of the head plate, on the inner side of which it is clinched. The small view shows how the teeth are attached and also the attachment of the central handle clip. The teeth are preferably of No. 8 steel wire, and it is designed that the total weight of metal in a rake 23 inches long, and having twelve teeth, shall be only one pound.

For further information relative to this invention address the patentee, Mr. Jonathan Paxson, No. 530 South Center Street, Pottsville, Pa.

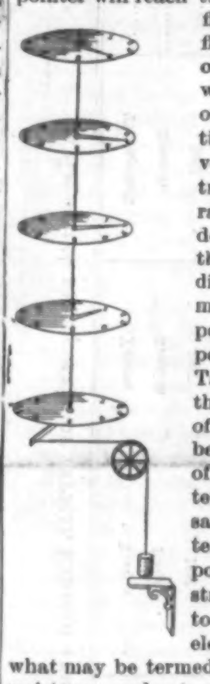
VOLT AND AMPERE ANALOGIES.

T. O'CONOR SLOANE, PH.D.

Considerable difficulty is experienced in appreciating the true relations of electric units. Any analogies drawn from more familiar or concrete things are useful if they are really apposite. In the cut are shown the lines of a simple experiment often used to show the phenomenon of torsion, which may be employed to illustrate the relations of potential difference, usually expressed in volts, to an electric circuit and to the current produced in it by the potential difference in question.

A vertical wire is attached at its upper end to a pointer moving over a dial graduated, as shown. To its lower end a lever is attached, to whose end a thread passing over a pulley and carrying a weight is fastened. Several intermediate dials are placed at even distances, the wire passing through their centers. To the wire, pointers are attached, one for each dial. The whole is so adjusted that when the weight rests on its support and the thread is tight, all the pointers stand at zero.

If the upper pointer is turned around, the others will share in its rotation to an extent inversely proportional to their distances from it. Suppose, in the arrangement shown, that the first pointer is turned to 4 and that the weight is just raised. Then the second pointer will reach the figure 3, the third pointer the figure 2, the fourth pointer the figure 1, and the lowest will move only an inappreciable distance. If we imagine the wire to be part of an electric circuit, and the rotations of the pointers to indicate voltage, we have an excellent illustration of fall of potential. The raising of the weight represents the development of a current. Thus the first pointer moving over four divisions, while the last does not move, indicates a difference of potential between the two extreme points of four volts or other unit. Taking the middle of the wire where the pointer stands at 2, a difference of potential of $(4 - 2 = 2)$ two volts between the upper end and center of the wire, as well as between center and lower end, is indicated. The same rule of uniform drop of potential will hold for all intermediate points. The wire is supposed to be structurally uniform, and references to proportional distances on an electric circuit refer, of course, to what may be termed electric distances, measured by resistance, and not necessarily by lineal feet or inches.

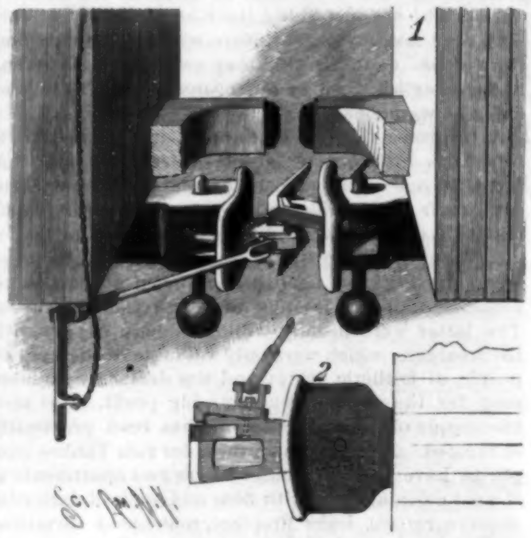


The ampere is the unit of intensity of current; it is not a unit of quantity, except indirectly. It is the current which a difference of potential of one volt will establish through a resistance of one ohm. It has in ordinary measurements one very close analogy that seems to have been seldom utilized in text books. In the Western States and Territories the flow of water is measured by what is known as the "miner's inch." It is the flow of water that will take place through a hole one inch square in a two-inch plank under a head of eight inches of water measured from the lower edge of the opening. The analogy is excellent between this and an electric current. The head of water represents the difference of potential, say of one volt, the opening in the plank represents a conductor of defined resistance, say of one ohm, and the water escaping, running out at the rate of one miner's inch, represents the current produced under the conditions, or one ampere. An ampere flowing for one second gives a quantity of electricity termed one coulomb; the miner's inch flowing for one second gives a quantity of water termed 0·1937 U. S. gallon.

Both units can be used without reference to time to indicate the strength in one case of a current of water, in the other case of a current of electricity. It shows how incorrect it is to speak of a current of any number of "amperes a second," instead of simply "amperes." If seconds are to be used, then the current should be spoken of as equal to so many "coulombs per second." Water flows at the rate of so many miner's inches, without any reference to time.

AN IMPROVED CAR COUPLING.

A car coupling designed to be automatic in its action, and in which the old form of drawheads may be utilized, is illustrated herewith, and has been patented by Mr. William A. Cooper, of West Grove, Pa. Upon the forward end of the drawbar are inclined locking limbs, of arrow-head form, and in its rear end is a slot for the insertion vertically of a pin, to the lower end of which a weight is secured, there being on the pin an adjustable collar adapted to engage the upper surface of the drawbar, and hold it normally in position for engagement with another drawbar, as shown in Fig. 1, while leaving sufficient room for its necessary vertical and lateral changes of position. In each drawbar, at one side of its arrow-head, is an opening for the reception

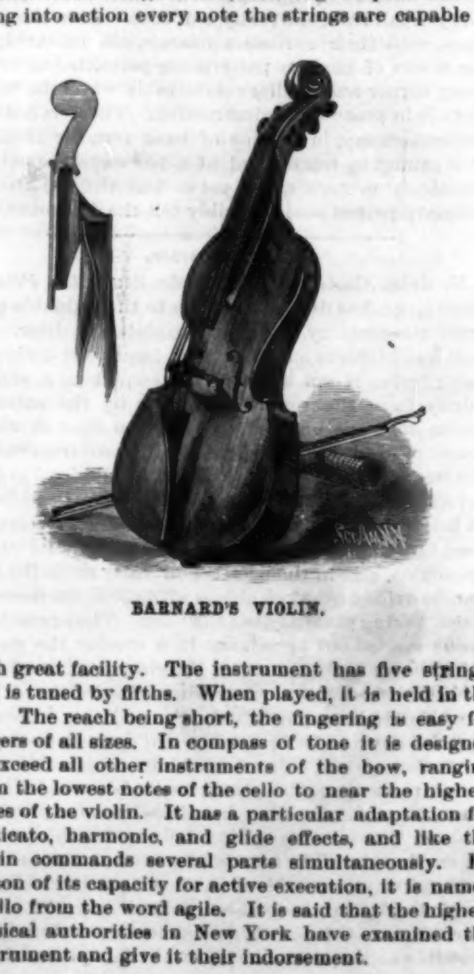


COOPER'S CAR COUPLING.

of one limb of a corresponding arrow-head on a mating car coupling, as indicated in the top plan view, Fig. 2. A tripping arm is pivotally secured to the side of the drawbar, a rocking bar extending thence to the corner of the car frame, where it has a jointed attachment with a swinging lever, to which is attached a chain extending to the car roof, that the lever and rocking bar may be operated therefrom. Near the outer end of the rocking bar is a coiled spring, whose torsional strength is adapted to hold the tripping arm in its normal position, aligning with the drawbar. On the outside extremity of the tripping arm is a toe, which extends laterally to lie below the forward end of a mating drawbar, and, by the operation of the hanging lever from either side of the roof of the car, an engaged drawbar is lifted sufficiently to disengage the limbs of the arrow-heads, thus detaching the couplings.

AN IMPROVED MUSICAL INSTRUMENT.

Prof. L. V. Barnard, of No. 16 Robbins Avenue, Pittsfield, Mass., is the patentee of a new instrument of the violin class, named Agillo. The neck is elevated and extended over the breast of the instrument, as shown by the illustration, thus forming an uninterrupted passage under the neck or fingerboard for the thumb, whereby the performer may guide his hand and carry it deftly from the first to the highest position without obstruction, while the special form of the left side of the upper part of the instrument—it being S-shaped and the edge of the breast curved or bent down—permits the hand and arm to move easily to any desired position on the fingerboard, enabling the performer to bring into action every note the strings are capable of



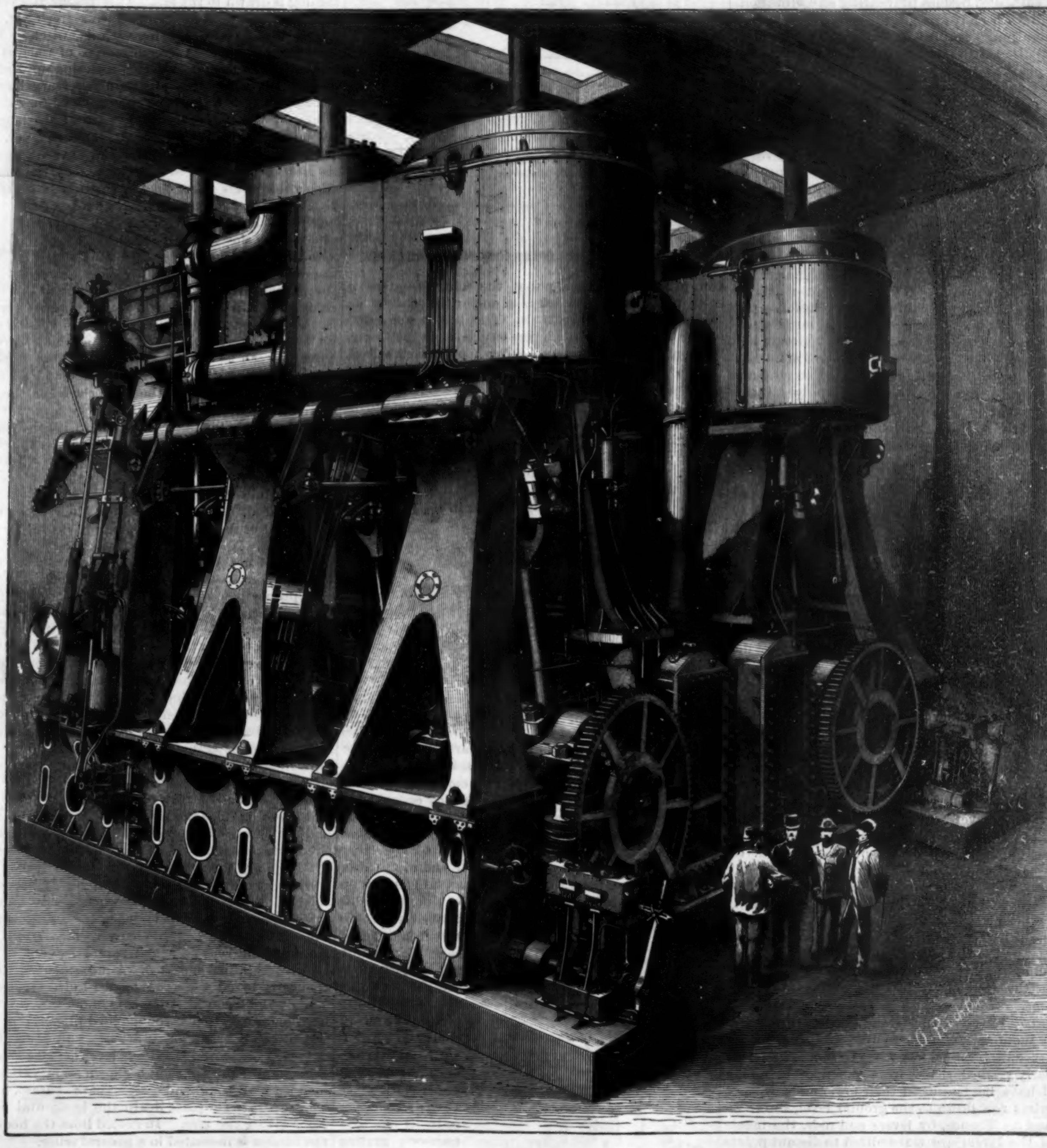
BARNARD'S VIOLIN.

with great facility. The instrument has five strings, and is tuned by fifths. When played, it is held in the lap. The reach being short, the fingering is easy for fingers of all sizes. In compass of tone it is designed to exceed all other instruments of the bow, ranging from the lowest notes of the cello to near the highest tones of the violin. It has a particular adaptation for pizzicato, harmonic, and glide effects, and like the violin commands several parts simultaneously. By reason of its capacity for active execution, it is named Agillo from the word agile. It is said that the highest musical authorities in New York have examined the instrument and give it their indorsement.

ENGINES OF THE AUGUSTA VICTORIA.

Among the recent additions to the fleet of great ocean steamers plying betwen New York and Europe is the Augusta Victoria, a magnificent ship, and one of the finest vessels in the world. Her propelling machinery is of the strongest and most costly character. There are nine main boilers, in three groups of three each, and each group, together with its coal supply, is piaced in a separate water-tight compartment. Six of these boilers are 17 feet 3 inches long and 15 feet 4 inches in diameter, and the remaining three are the same length, but 14 feet 3 inches in diameter. All the boilers are double ended. The material used is steel. In these boilers very great care and attention on the part of the builders during construction was necessary, as the German authorities require dimensions, scantlings and work much in excess of Lloyd's or the Board of Trade. In each boiler there are six Purves ribbed flues. The total heating surface is 35,000 square feet, and total grate area 1,220 square feet. The working pressure of steam is 150 pounds per square inch. Each group of boilers is supplied with a separate feed pump and temperature compensator or feed heater. Feed injectors are also fitted to each boiler. The main steam pipes are so arranged that any one boiler or group of boilers can be used or shut off, as the case may be. As regards the main steam pipes, they are of copper, and very great care has been taken with their construction, and, as an additional precaution, each pipe is served over with crucible steel 7-18 wire.

The screws are revolved by two sets of tri-compound engines, herewith illustrated, each set capable of developing 6,250 horse power. The cylinders are 40, 66 and 101 inches in diameter, stroke 66 inches. All the cylinders are jacketed. The cylinders are carried on extremely massive, double-legged box columns. Steel is freely used in the moving parts of the machinery. The reversing gear is by Allen, and is very rapid and noiseless in its action. The shafting is of steel and is hollow. It was made by Krupp, of Essen. The crank shaft is 20½ inches in diameter, the tunnel and propeller shafting being 19½ and 20½ inches in diameter respectively. The thrust block is unusually large, and is of the adjustable open "horseshoe" pattern. All the main shafting bearings are of white metal, and ample surface is provided. The glands in the engines are packed with the United States Company's metallic packing, and throughout the long trial trip, with the engines at full speed the whole time, all the glands not only remained tight, but the piston and slide rods were as bright as possible, and no trouble was experienced on this head whatever. Chadburn's deck and engine room telegraphs are supplied, also helm and bridge telegraphs. Chadburn's engine room counter is used, and on the bridge Allison's motograph—a very useful and ingenious invention—is supplied for each engine. The motograph is of simple construction, and is actuated by a current of air contained in a copper tube leading from the engine room to the bridge. It is of great value to the captain, officer or pilot on the bridge, as it at once assures them that their orders are being executed, and removes all anxiety on their part as to which way the engines are going, thereby enabling the officer in charge to at once have the engines stopped or reversed, and thus avoid collision or other damage that might occur from any misunderstanding of the orders transmitted from the bridge. The motograph also shows on the bridge the number of revolutions the engines are making. It also registers the direction in which the engines were last moving—ahead or astern, as the case might be—and remains so until the engines are again reversed, and it also obviates the necessity of a man standing by in the engine room to reply to the bridge, the engines themselves automatically indicating the reply on the motograph. Lubrication in the main engines is most ingeniously effected by means of Bischoff's lubricators. Auxiliary condensers are placed in each engine room to take all the exhaust steam from the winches and small engines, galley, etc. Each of these condensers is fitted with an independent air pump and circulating pump. An excellent installation of fire pumps is supplied. The engines are separated by a water-tight bulkhead extending to the upper deck.



ENGINES OF THE TWIN SCREW EXPRESS STEAMER AUGUSTA VICTORIA.

The slides for the H. P. and I. P. cylinder are of the piston type, and in the L. P. cylinder the long D slide is fitted with a balance back. All the slide rods are balanced. The slide valves are worked by the ordinary link motion of the single bar type. Tail and piston rods for the cylinders are not fitted, but the shoes on the piston rod heads and the guide plate of the column are given very large surfaces. The pistons themselves are very deep. Condensers are placed at the back of the engines, and are of the usual surface pattern. The air pumps are driven by a rocking lever off the L. an

H. crossheads. These are the only engines driven in connection with the main engines. Bilge, feed, and each circulating pump are driven by a pair of independent engines, made to a special design by Tangye.

There are two three-bladed steel propellers, their diameter being 18 feet, and 32 feet pitch. The total blade area is 96 square feet, and the total disk area is 509 square feet. The bosses are of steel and are 4 feet 6 inches in diameter. The bosses are recessed to admit the flanges of the blades. They are so constructed that when the blades are fitted the boss is as spherical as possible; covers are fitted on the after end of the bosses, and the whole is a very complete job. A peculiar feature in the stern is that there is an aperture similar to that in single screw vessels. This aperture is of great service, as it enables the propellers to be run at greater efficiency, besides preventing any vibration. It also facilitates the turning of the ship.

A distinguishing feature is the excellent electric light installation. It is seldom, indeed, that such a complete plant is seen, except on board warships. The plant consists of three sets of combined engines and dynamos, supplied by Von Bremen, in conjunction with Siemens Brothers, of London. The dynamos are compound wound, and are of Siemens' latest type. Current is delivered at an E. M. F. of 110 volts. The plant is in triplicate, the third set being for daylight use. The spindle of the armature revolves in long phosphor bronze bearings. The engines are compound, vertical, and direct acting. The shaft is coupled direct to the armature spindle, and engines and dynamo are bolted to one bed plate. These engines are of very good design and make. The cranks are balanced, and massive flywheels are fitted. The engines and dynamos make 350 revolutions per minute. The main cables are led to a large slate-based hardwood main switchboard. Each circuit has its own main switch cutout, voltmeter and ammeter, these last being "dead beat" in their action and are by Schaffer & Budenberg, who also supply all the gauges throughout the ship. The lamps are incandescent 110 volt lamps, by Edison & Swan. They are of the "capped" kind. For the saloons, frosted globes are fitted. Group lamps are supplied for the masthead and side lights.

The Victoria Augusta belongs to the Hamburg American Packet Co., C. B. Richard & Co., agents, 61 Broadway, New York.

THE MECHANICAL INTERLOCKING SWITCH AND SIGNAL SYSTEM AT THE GRAND CENTRAL DEPOT, NEW YORK.

[*Continued from first page.*]

been operated. In this way their movements are made interdependent and have to follow certain and definite orders of movement, which are susceptible of any desired variation. When the order of movement of a set of levers has been fixed by the adjustment of the interlocking mechanism, it cannot be departed from in operation. Thus, taking the simplest case of a switch and signal, two levers with interlocking movements might be used, one for the switch and the other for the signal. These would be made to interlock, so that before the signal could be turned to show "safety," the switch must be set to leave the line clear. Before the switch could be reversed, the signal would have to be set to danger. This is not all. It may be that to give a clear track four or five switches may need setting. In this case they would be made to interlock together and with one or more signals, so that the latter could not leave the "danger" position and show "safety" until all the switches had been properly set.

Into the safety of the trains running over the system, as factors of safety the watchfulness of the train hands and of the switch men enters as well as the perfection of the system. It does not eliminate human intelligence.

The signal tower in the Grand Central station is a two-story building, upon whose upper floor are placed the levers and interlocking mechanism. The levers stand nearly vertical, rising from the floor in a long row, and have bent arms at their lower ends, whence rods or wires run down to the ground level, shown in Figs. 1 and 3. Thence, by levers and rods, the movements of the levers are transmitted to distant points and in all directions. The rods running along the tracks are carried on pulleys bolted down to the ends of the sleepers or to special timbers. The view (Fig. 4) of an engine passing a switch shows this feature clearly. In the manipulation of the switches a special contingency has to be guarded against by means shown in the same view. It is the throwing of the switch while a train is passing over it. This would send part of the train one way and part another, and might even send the two trucks of a single car on different tracks. Along the rails of each track affected by the movement of a switch, a bar of iron about forty feet long is carried, working on pivoted arms like those connecting the members of a parallel ruler. This bar is thrown back and forth each time the switch is moved, swinging through the arc of a circle and above the rail in so doing. When a train is passing over a switch some of its wheels are always over this bar and preclude the possibility of moving it. Such a bar is termed a detector bar, and really makes a part of the interlocking system, the engine and train locking its own switch. In the same view is shown a lock for switches worked by lever from the tower. Its general construction is obvious. A bar attached to the swinging point of the switch reaches across the track. Near its center it is perforated by two holes, and a bolt, axial with and moving in the direction of the track, is arranged to pass through one or the other of these apertures. They

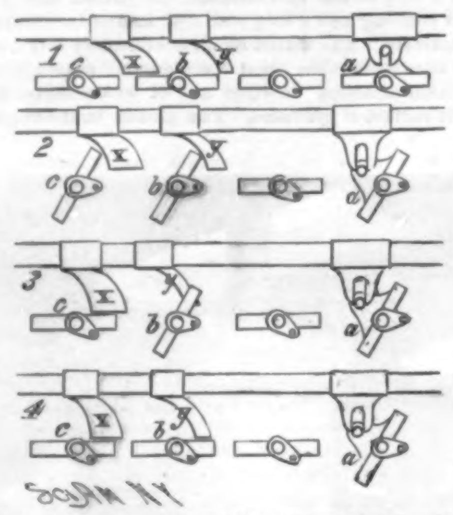


Fig. 5.—DIAGRAM OF INTERLOCKING MECHANISM.

are spaced so far apart that the bolt will enter the holes only when the switch is in one or the other of its two positions. This locks it. The bolt is connected by cranks or rods and levers to a lever in the tower. For some places a similar locking mechanism is used, placed to one side of the track. These locks enter also into the action of interlocking.

Signals may be of any type. In the Grand Central yard lantern signals are used, mounted so as to turn through an angle of 90°, and show red or white to the engine driver. Red indicates danger, white indicates safety. They are worked by connecting rods exactly as are the switches and switch locks.

The principal interlocking is done in the tower. In

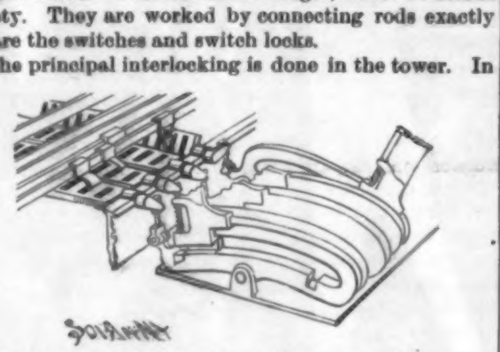


Fig. 6.—DETAILS OF INTERLOCKING MECHANISM.

front of the operatives and on the farther side of the levers is the interlocking mechanism, shown in Fig. 1. In general principle it is simple; its complexity is due to the fact that it can be adapted to any conceivable contingency.

Below the levers are a series of curved links pivoted at the center of their lower surface. As the lever swings backward, it swings the rear end of the link down. This particular movement may be effected by the separate hand piece and connections on the front of the levers. To the front end of each link a short rod or pitman is attached that rises vertically therefrom. In front of each lever and extending across and underneath the series of upper rods is a long narrow grating pivoted at its ends. At the rear end, or the one nearest the lever, is a crank to which the pitman is attached. The details are shown in Fig. 6. In the normal position of the lever the pitman is drawn down and the grate is horizontal. When the lever is drawn backward, the pitman is pushed upward and the grate is thrown out of horizontal to an angle of about 45° from the same. Hence a lever cannot be moved without a grating moving with it. If the grating is held fast, the lever is locked. Mechanism is provided by which any lever may be made in its movements to lock fast any one or more grates and so prevent the levers connected therewith from being moved. This constitutes the typical interlocking. Across the gratings above and below them run a series of rods, one for each lever if necessary. A pin and slot connection is made between the rod and the grating belonging to the lever in question, so that as the lever moves and actuates the link, pitman, and grating it also causes the rod to slide in one or the other direction at right angles to the axis of the grating. In Fig. 6 the farther lever is thus connected. One or more projecting dogs are bolted to the rod, projecting downward from its lower surface. Two are shown in Fig. 6.

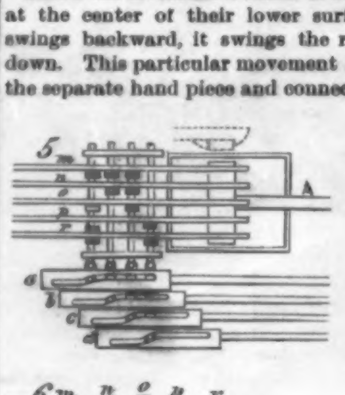


Fig. 7.—GENERAL PLAN OF SELECTOR.

These are of such a length as just to clear in their movements the upper surface of the grating. If, when the lever is normal, a dog is so placed as to come over the rising side member of a grating, then this grating cannot be moved, and its corresponding rod and switch or signal, as the case may be, is locked. But as the lever is drawn forward, the rod slides and the dog is drawn to the left. This brings it over one of the openings of the grating, thus freeing it. The lever attached to this grating with its switch or signal can now be moved. A second series of rods extends under the grates, and by dogs projecting upward also locks them, thus economizing in necessary length of grates. Sixty-two apertures are provided for rods, and as some of the rods extend only part of the length of the series, there is room for a rod for each lever.

To show how the interlocking can be varied and how its movements affect or are affected by the order in which the levers are moved, a diagram is given, Fig. 5. In it a, b, and c represent the ends of three gratings, the same as shown in Fig. 6. The grating a is attached by slot and pivot to a rod carrying the dogs x and y. The lever connected to this grating works the rod to right and left. The crank arms to which the pitmen are attached are also shown. In the position shown in No. 1 the lever belonging to grating a is normal; grating b with its lever and grating c with its lever are free, and the switches or signals connected therewith can be moved. After these are moved the lever of grating a can be thrown over and all can be fixed as shown in No. 2, the dogs catching the edges of the grating. In No. 3, starting with the levers at normal, or, what is the same thing, with the gratings horizontal, grating a has first been moved, locking c but bringing a dog over the opening in b, leaving it free to move and its lever has been thrown. In No. 4 it is shown how b and c can be locked by dogs differently spaced, being brought over their edges by the movement of the lever corresponding to grating a.

The above is simply given as an example of the possibilities of the system, and not to illustrate any special combinations.

At proper places in the yard selectors are placed. They enable one lever to do in a certain sense the work of a number. The rod from such lever running along the ground terminates in a box. From the other end of the box several rods issue, as shown in the cut, Fig. 7, No. 5, five in number. The ends of these have vertical play of about an inch. If dropped, they hook on to an extension attached to the main entering rod, A, and are actuated by it. If raised, they are disengaged and cease to be actuated. To raise and lower them, bars slide under them at right angles, carrying inclined planes. As these bars are pulled in the one or other direction, the five rods, m, n, o, p, r, are raised and lowered. The inclines can be set to right or left, and can be varied in number so as to produce any desired combination. These inclined bars are actuated by obliquely slotted plates, a, b, c, d, attached to and worked by other signal or switch rods. Thus, suppose rod a is connected to a switch whose safety signals are set by rods n and p. Then when the switch is thrown the left hand bar is thrown over, raising out of engagement the rods m, o, and r, and leaving in action rods n and p, just specified. A movement of the lever connected to rod A sets the signals. In the same way rod b and c and d can be taken care of, and by varying the position and setting of the inclined planes, one to five signals can be set in any order determined by the rods a, b, c, d, all through a single lever attached to rod A.

In No. 6 of the same cut is shown an elevation of the inclined planes and end sections of the bars m, n, o, p, r. The apparatus in place lies in the horizontal position, No. 5 giving the plan. In dotted lines the hooking-on mechanism is indicated in a general sense.

The effect of these selectors and of other features of the installation is to reduce the number of levers. On the system in vogue a few years ago, 176 levers would have been needed to do the work of the yard. In the present plant, where one lever often does the work of a number, either by working lock, switch, and detector bar at one stroke, or through selectors, only 87 levers are employed.

The system was put in by the Union Interlocking Switch and Signal Co., of this city. After three months of work without interfering with the old plant, the connections were made, practically with no interruption to traffic. A portion of the interlocking was disconnected for four hours on a Sunday morning.

It will be seen that by varying the shapes of dogs and their positions, any desired combinations can be effected. The designers of such systems become very expert, and can work, it is said, by a sort of intuition in carrying out the interlocking.

Correspondence.

A Beautiful Meteor.

To the Editor of the Scientific American:

On the night of January 24, at 8:40 P. M., I saw a light rise in the west horizon. It looked like a rocket until it came near the zenith. Then a meteor with two heads about the size of first magnitude stars, apparently 20 inches apart, with a foggy light over three yards long, shot east about 15° south of zenith. Have any of your readers seen it, and what was it like?

L. B. WILSON.

Philadelphia, Pa.

Carbolic Acid for Carbuncles.

To the Editor of the Scientific American:

Dr. Boggs, in your issue of December 21, errs in crediting Professor Verneuil, of Paris, with the introduction of carbolic acid in the treatment of carbuncular affections. If Dr. Boggs will refer to the New York *Medical Record*, or Sansom's great work, he will find that Dr. Cleborne, of the United States navy, *first* injected carbolic acid subcutaneously, and swabbed out buboes with the *crystallized* acid; and he was followed some time later by Dr. Taylor, of the army, who injected the acid diluted with glycerin or water in the treatment of boils.

The use of carbolic acid for the cure of carbuncles, boils, buboes, etc., is, therefore, an *American*, not a French invention.

A. SMYTHE PALMER.

Washington, D. C., January, 1890.

An Improvised Organ Pipe.

To the Editor of the Scientific American:

Chance led to an experiment in acoustics the other day. Wishing to dry a bottle of two liters capacity with an opening at the mouth of about three centimeters, I inserted a Bunsen burner with a blue flame about three centimeters long, into the bottle, which was held bottom upward. The bottle immediately resounded with a full tone, like an organ pipe, which continued till the flame was beaten out. The bottle was a resonator, or stopped pipe, for the flame. Various other bottles were tried, but no other was found which gave a musical note when the flame was introduced into it.

Others may have found this out before, but I have not heard it before.

W. C. P.

How to Sharpen a Razor.

To the Editor of the Scientific American:

I have ascertained that razors can be quickly and efficiently honed in a manner different from that usually employed. Thinking the subject might be of interest to some of your subscribers, I send you a description of the process. Use two hones, an Arkansas oil stone and a fine razor hone. The razor is first applied to the Arkansas stone, using fair pressure, and finishing with lighter and lighter pressure strokes. Remove razor from the coarse hone to the fine razor hone, upon which oil is also employed. With a few light strokes on the fine hone, an enduring, hair-splitting edge is formed. If the razor be kept on the finishing hone too long, the fine edge will be lost. If this be the case, the process must be repeated, that is, the razor is again applied to the coarser hone and again finished upon the fine hone, care being taken to cease honing after the razor has acquired the hair-splitting edge. Very little practice is required to ascertain when that point is reached, a few hairs of medium fineness supplying the required test. No doubt other instruments requiring very keen cutting edges could also be sharpened in manner indicated. The coarse hone employed should be of sufficiently fine texture to put a smooth edge on a pocket knife, but not fine enough to give a smooth cutting edge to a razor.

E. S.

Philadelphia, Pa.

A Beautiful Atmospheric Phenomenon.

To the Editor of the Scientific American:

The city of Williamsburg, in Virginia, is situated on that ridge of land known in history as "The Peninsula." It is about two hundred feet above the level of the sea, and is separated from the rivers by well wooded land, the tall trees effectually concealing all trace of the billowy streams, which in their ebb and flow have carried out and brought in the messengers of commerce which have for nearly three centuries connected America with the nations of Europe. These rivers can only be descried on a clear day from the highest towers of the town. On the morning of January 3 they lay uncovered before the astonished eyes of the inhabitants, seemingly not more than a mile away, blotting out, in their turn, the trees by which they had been so long concealed. On the north lay the York in blue light, with the shores of Gloucester distinctly outlined on the further side. Shades of color produced by the dashing waves and varied depth of the water were well marked. On the south, the James unrolled its tawny length, stretching off on the one hand to the old historic island of Jamestown, and on the other, sweeping with majestic curve, lapped the marl banks of Carter's Grove, then widening out into Burwell's Bay, passed out of view fifteen miles away. The scene was one of rare beauty and interest; the panorama thus unfurled an appropriate welcome to the decade of 1890.

The phenomenon can be accounted for on scientific principles. The entire month of December was one of peculiar warmth and dryness. On the morning of January 3, a light, cool wind sprang up from the north, laden with humidity. The dense vapors that had settled in the river bottoms were disturbed. Two strata were formed of varying density, and at the point of union the separation of the ray of light limned the charming landscape. The wand of Morgan la Fay was waved over the land, and a scene of fairy enchantment delighted the eye.

CYNTHIA B. T. COLEMAN.

Williamsburg, Virginia.

PHOTOGRAPHIC NOTES.

Coating White Celluloid Sheets with Sensitive Emulsions for Positive Pictures.—Speaking of these positive pictures, the *Br. Jour. of Photo.* says: Failing the possibility of obtaining the sensitized celluloid, it is not a difficult matter for the photographer himself to coat it with emulsion.

Any good, slow emulsion will answer well for positives, but it is better that it should for the purpose contain a larger proportion of gelatine and less silver than is usual when a negative image is required. This gives a more transparent deposit, and adds to the depth and richness of gradation.

It will not be found convenient, working on a small scale, to coat the full-sized sheets, nor, indeed, anything much exceeding one-sixth of the dimensions, owing to the difficulty of getting the flexible material to be perfectly flat. We have tried a variety of ways of securing this end, but find nothing more convenient than to squeegee the celluloid on to a sheet of plate glass previously coated with an adhesive material, such as india-rubber solution or one of the adhesive plasters obtainable at any chemist's. A very thick mixture of gelatine and glycerine, similar to the well-known "graph" composition, answers well if the emulsion is not too hot when poured on, and we have even succeeded by simply wetting the glass before laying down the celluloid. What is required is simply to retain the sheet in contact with the glass until the emulsion has set, after which it may be stripped off and hung up to dry.

The size of the sheets coated will depend upon the sizes to which they are subsequently to be cut; it should not be too great, owing to the difficulty we have mentioned, nor too small, or extra time and labor will be wasted in coating. The cabinet size cuts rather awkwardly into 50 × 20 so as to use the material to best advantage, though for general purposes the dimensions are very convenient. Whatever size be selected, care should be taken to allow for cutting off bad edges, which are more liable to occur with celluloid than with glass.

The next point is the cleaning or preparing the surface to receive the emulsion, and this is a rather difficult task, owing to the apparent greasiness of the celluloid. The trouble is vastly lessened by slightly abrading the surface; but then, for some purposes, the beauty of the imitation ivory picture, especially in small sizes, lies in its fine though unobtrusive polish. If a matt surface will answer, then the polish may be removed by friction with prepared chalk, made into a thin paste with alcohol; or, perhaps, a better plan is to pour plain methylated alcohol on and off a few times, when, upon setting it aside to dry, the surface will be found to have lost its fine finish. A little ether may be added to the alcohol to increase the matt effect.

When it is requisite to preserve the high polish, some other means must be adopted of causing the emulsion to take to the repellent surface. Similar precautions are frequently taken in conjunction with glass, such as applying a preliminary coating of such solutions as silicate of potash or sugar, and these might answer with celluloid, though we are not in favor of such applications. Polishing with powdered talc we have practiced with success, though it occasionally fails; but to make assurance doubly sure it is better to follow up the latter treatment by giving a coating of plain gelatine solution containing 10 grains of gelatine, ¼ grain chrome alum, and ½ drachm methylated alcohol to each ounce of water. This may be poured on to the leveled celluloid, or the latter may be floated on the gelatine, and the surplus in either case drained off without waiting for it to set. Before placing the coated sheet away to dry, examine it carefully to see that the gelatine has not run away from any portions; if it has, the bare portions must be rubbed with a piece of sponge dipped in the gelatine solution and the coating or floating repeated.

When the celluloid so prepared is dry, it is ready for coating with emulsion, which will then take readily to the surface and adhere perfectly. For coating, let the celluloid be laid down upon glass in the manner described, and then covered with emulsion just as if it were a glass plate only, the film and support being laid upon a leveled slab to set in the ordinary manner. When set quite hard, insert the point of a penknife between celluloid and glass, and the two will part readily, and the sensitive film may be hung up in the drying cupboard to dry.

In cutting up to size, a glass shape and a pair of long bladed scissors will prove more satisfactory than any form of cutting or trimming knife, owing to the thickness and toughness of the material; but undoubtedly the best way of reducing the sheets to standard and uniform size, where it is available, is the card or mount cutting machine that now is to be found in many studios. This is at once expeditious and accurate, and nothing is so essential to neatness of finish or accuracy in cutting.

Collodion emulsion may be substituted for gelatine if preferred, but if applied to the bare celluloid will slightly lower the gloss, and at times tend to produce a slightly sunken appearance in the shadows. The preliminary coating of gelatine obviates this, thus retaining the full polish and giving brilliance and transparency to the image.

Pictures, whether portrait or landscape, should be printed under a mask, in order to provide a clear, white margin, except in the case of those of large size, which are better framed or mounted without margin. If protected by means of a suitable varnish, such pictures may be placed in albums or framed without glass, and exhibit little tendency to succumb to the ordinary wear and tear to which such things are subjected.

We repeat, in conclusion, our surprise that so little has been done in this kind of picture; but perhaps some of the plate makers will, ere long, remedy the neglect by placing the coated celluloid for positives on the market.

Compound for a Twenty Thousand Candle Power Magnesium Light.—The *Moniteur de la Photographie* gives a receipt for magnesium light, which gives, when burning, a light of twenty thousand candle power. The mixture recommended is as follows:

Magnesium powder	20 parts.
Barium nitrate	30 "
Flower of sulphur	4 "
Beef suet	7 "

The suet is melted and kneaded up with the mixture, which is filled into zinc cases, 10×7 cm. Each such case holds about a pound, and will burn for twenty seconds, giving a light that may be seen at a distance of sixty miles. This appears to be perfectly possible, for Dr. Miethe, who some time ago experimented with signal rockets containing a mixture of magnesium powder and chlorate of potash, found that the light emitted was visible from Potsdam to Oderberg.

Recent researches by Signor Vittorio Aducco (published in the *Atti della R. Accademia dei Lincei*) seem completely to confirm the earlier results arrived at by Moleschott, that change of tissue in the animal organism is promoted by the action of light. Change of tissue, on the other hand, in the case of animals confined in the dark, takes place so slowly, and to such a small extent, that the nutriment ordinarily in reserve in the body is quite sufficient to keep life from becoming extinct for a very long time. We shall not be surprised, says the Italian paper, to find the vegetarians making capital out of this piece of information, and recommending those desirous of living cheaply to supplement a vegetarian diet by existence in a darkened room!

Protection of Fruit Trees from Mice, Rabbits, and Woodchucks.

The Massachusetts Agricultural College, located at Amherst, issues bulletins occasionally, giving results of their experiments, which are useful to the farmer and all persons interested in horticulture. In the last issue of the bulletin, just published, we find the following directions for ridding fruit orchards of pests which are sometimes very destructive:

Another season's test, says Samuel T. Maynard, professor in the division of horticulture, has confirmed the results of our experiments of previous years in protecting trees from injury by girdling, and as numerous letters of inquiry for means of protection from girdling by mice, rabbits, and woodchucks have been received, we give the results of our experiments up to date.

In addition to the simple mixture of lime, cement, and Paris green wash, we have found, if the above be mixed with skim milk, it adheres better than if mixed with water; in some cases adhering firmly for six months or more.

Portland cement adheres more firmly than the Rosendale, and is more satisfactory when not mixed with milk than the latter.

Several reports have come to us of young trees having been injured by woodchucks during the summer, and in one case we can report that out of more than 1,000 trees treated with cement, milk, and Paris green, not one was injured during the past summer, while many not painted were seriously injured.

The amount of Paris green used was one tablespoonful to each two gallon pail full of paint, mixed so as to easily apply with a paint brush.

A NEW ELECTRIC CONDUIT FOR STREET CARS.

Recent developments in electricity have demonstrated the necessity of provision for greater safety in the use of heavy currents. It has been shown that are light currents are particularly dangerous. It is known also that objectionable and even dangerous shocks may be given to men and animals by such currents as are used in the propulsion of street cars.

We illustrate a conduit for electric railways in which all dangers of this kind are avoided. In this system the conductor is entirely out of reach, and an electrical connection can be established only upon the portion of the railway occupied by the car. A clear understanding of this invention may be had by examining the parts of the railway and car from which portions are broken away to show the interior.

The car, A, runs upon the railway track, B, and is provided with an electric motor, C, which is geared to one of the axles of the car in the usual way. Underneath the car is suspended a series of electro-magnets, D, which extend downwardly to a point near the electrical conduit, E. These electro-magnets are inclosed to protect them from dirt or injury, and also to prevent them from gathering particles of iron.

The conduit, E, is formed of a tube having a top made up of sections, *a*, of non-magnetic material, insulated from each other and the body of the conduit. In the bottom of the conduit, E, is arranged a conductor, F, which is thoroughly insulated. To the conductor, F, are attached standards, *b*, to which are secured flat springs, *c*, carrying at opposite ends pieces of iron, forming armatures. The normal position of the springs is horizontal, but when the magnets, D, pass over the springs, they are raised up into contact with the sections, *a*, producing an electrical connection between the conductor, F, and these sections.

To the bottom of the car are attached brushes, *d*, which are adapted to take the current from the sections, *a*, as the car passes along. The current passes from the brushes through the motor, C, a small portion of it being shunted through the magnets, D. The current returns to the generator through the wheels of the car and the railway rails. It will be noticed that an electrical connection with conductor, F, can be established only when the armatures carried by the springs, *c*, are drawn up by the magnets into contact with the sections, *a*, so that anything touching the sections, *a*, which are not in the electric circuit will be no more affected than it would be by contact with the paving stones. As the car passes along, the armatures carried by the springs are released and the springs returned to their normal position. The surface of the sections, *a*, are cleaned by brushes located at the ends of the car.

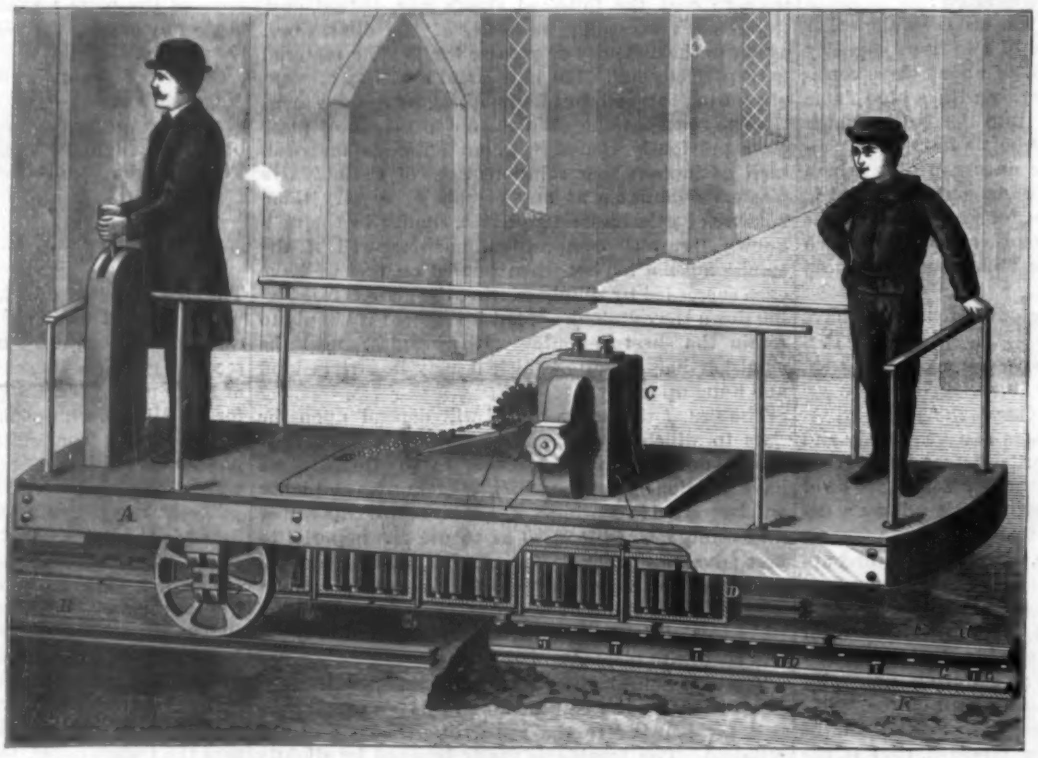
Not only is perfect safety secured by this improved system, but the accumulation of mud and water in the conduit is avoided by sealing it from end to end. As the sections, *a*, are insulated from the conduit and from each other, the current cannot be transmitted from one section to another. It is the intention of the inventor to maintain a constant circulation of air through the conduit, to prevent the condensation of moisture, and thus avoid the accumulation of water.

This system consists almost entirely in the conduit and the electro-magnets and brushes carried by the car. Any good electrical motor can be applied to the car, and the current may be supplied by any dynamo of approved construction.

This invention may be readily applied to existing surface railroads, and the expense of applying will be less than one-half that of other systems, as it is not necessary to disturb the roadbed or cut the ties. The conduit may be placed directly upon the ties, or above the ties.

The current is carried directly to each car, and the chances of leakage are reduced to such a degree that the loss from this cause may be left out of calculation. This system also has a great advantage on single track roads, as it may be applied to turnouts and switches without any complication, and the conduit may be carried around sewer manholes and other street obstructions. The difficulties arising from the use of a slotted conduit are entirely avoided.

Mr. Harry W. Smith is the inventor of this system, and the Smith Electric Conduit Company, of 130 Broadway, New York, are the promoters of the invention.



A NEW ELECTRIC CONDUIT FOR STREET CARS.

The Outlet to Lake Superior.

Lake Superior, the greatest of our wonderful inland seas, has an area of 32,000 square miles, is 350 miles in length, and 900 feet deep. Its outlet is at its western end, through the St. Mary's River, a narrow and dangerous stream, obstructed by falls and rocks. The improvement of this river was first begun by the State of Michigan in 1852, and in 1855 the first lock was opened, with a depth of 11½ feet. Since that time the general government has greatly enlarged the locks and improved the river, and the commerce of the lake has correspondingly increased. Congress is now asked to appropriate five and a half millions of dollars for further enlargements and improvements. There are few more necessary public works than this, and none that promise such immediate returns of the costs in benefits to the country. An able address in advocacy of this great work was recently delivered in the Senate of the United States by the Hon. Cushman K. Davis, of Minnesota, from which we make the following abstracts:

The distance from the city of New York to Duluth, at the head of Lake Superior, is 1,400 miles, of which 800 miles are deep water navigation, by way of the great lakes. The only outlet from Lake Superior is the St. Mary's River, which is 75 miles in length. The fall in this distance is 20 feet 4 inches, and of this 18 feet 2 inches are at the falls. The only channel now navigable is, for the first 35 miles below that place, so tortuous that passage through it at night is unsafe and is not attempted. For the remainder of the distance to Lake Huron the navigation is good.

The great increase in the number of vessels and in the quantity and value of freight conveyed through the lock demonstrates that before the present improvements can be completed the lake commerce will be under the most pressing necessity for their use. In 1889 the number of vessels passed through lock was 9,579; freight tonnage, 7,516,022; valuation, $83,732,527.

In 1888 the entries and clearances from the port of New Orleans were, registered tons, entries, 721,128; registered tons, clearance, 727,520; total, 1,448,648.

During the same year the registered tonnage locked through the St. Mary's Canal was 6,411,423 tons. The United States expended six and one-half millions of dollars in deepening the channel at the mouth of the Mississippi River and into the Gulf. In this it did wisely. The error was, as here, that the work was delayed too long.

The total registered tonnage entered and cleared in all the ports of the United States from and to foreign countries in 1888 was 31,062,007 tons. In the same year the registered tonnage through this lock was (estimated) 6,200,000, being about 20 per cent of the amount of tonnage entered and cleared in that year from all the ports of the United States in its foreign commerce.

Consider the commerce of a single city during the year 1889—the city of Duluth. The shipments of iron ore from that point were 826,814 tons, as against 504,110 tons in 1888, an increase of 320,000 tons in one year. The shipments in 1884, when export from the Minnesota iron mines began, were only 62,122 tons. This ore is of the finest quality. It is produced from the Iron Range of Minnesota. These mines are inexhaustible. Six years ago that region was utterly uninhabited. It is now the seat of great mining operations, which are rapidly increasing. It is traversed by railroads, and cities have sprung up in the wilderness.

The wheat received and shipped from that port in 1880 was 8,021,837 bushels. There were received 17,310,605 bushels in 1889. The shipments of flour in 1883 were 891,800 barrels; in 1889 they were 2,020,953 barrels. Nearly all of this is the product of the greatest flouring mills in the world, those of Minneapolis, whose output has in six days been 187,050 barrels, an average of 31,175 barrels each day. The elevator capacity is 19,500,000 bushels.

In 1883 the coal receipts at Duluth were 420,000 tons, as against 1,045,000 tons in 1889. The arrivals and clearances of vessels at this port in 1889 were 2,554 vessels, of registered tonnage 2,475,195.

The length of dock line is 16·27 miles; the length of dock face is 115·30 miles.

The following railways and railway systems connect directly with these docks:

	Miles.
St. Paul and Duluth	252
Northern Pacific and branches	3,850
Chicago, St. Paul, Minneapolis, and Omaha, and connecting branches	7,067
St. Paul, Minneapolis, and Manitoba	3,160
Duluth and Iron Range	117
Duluth, South Shore, and Atlantic	529
Wisconsin Central	775
Milwaukee, Lake Shore, and Western	605
Duluth and Winnipeg	70
Duluth, Red Wing and Southern	25
Total	16,455

This is but the statement of the commerce of a single city. That of Superior, Ashland, Houghton, Marquette, Ontonagon, and other ports in which is comprised the enormous output of the iron and copper mines of Wisconsin and Michigan, goes to make up the vast aggregate expressed by the statistics of the operations of the canal and lock.

There can be no doubt that a case of urgency is presented by the present situation.

Dried Fruits, Nuts, and Honey.

The follwing statistics of the fruit and nut products of California for the past year show what phenomenal strides that country is making in its fruit culture. As usual at this season, says the California *Fruit Grower*, the annual reviews of the various lines of trade are being issued by enterprising firms in this city. While we do not agree with all their estimates, they furnish a good idea of the quantity of each variety produced in the State during the season of 1889. The following figures are taken from their reviews:

	Pounds.
Raisins, 900,000 boxes	18,000,000
" sacks	1,000,000
Dried grapes, sacks	2,000,000
Prunes, French	15,000,000
" all others	200,000
Peaches, unpeeled	2,500,000
" peeled	200,000
" sun dried	500,000
Apricots	2,000,000
Apples, evaporated	400,000
" sun dried	100,000
Nectarines	200,000
Plums, pitted	200,000
Figs, black and white	100,000
Pears	50,000
Almonds	500,000
Walnuts	1,500,000
Honey	2,200,000

Making Sodium Globules.

Sodium may be obtained in fine, clean globules by half filling a small beaker with water, adding to this about an inch layer of paraffine oil, and plunging pieces of sodium, on the point of a wire, through the oil into the water, where they will be superficially oxidized, detaching themselves from the wire, and floating to the surface of the paraffine. In case there should be globules of water in the oil, they may be got rid of by standing in a tall bottle for a few hours, when they will sink to the bottom. I have found this oil an excellent liquid for the preservation of sodium, as it has the advantages of cheapness, non-volatility, and non-explosiveness, which "potassium naphtha" has not. These globules are especially useful for demonstrating the properties of the metal. They float on the oil, but sodium coated with oxide, as in the commercial metal, does not.—*English Mechanic.*

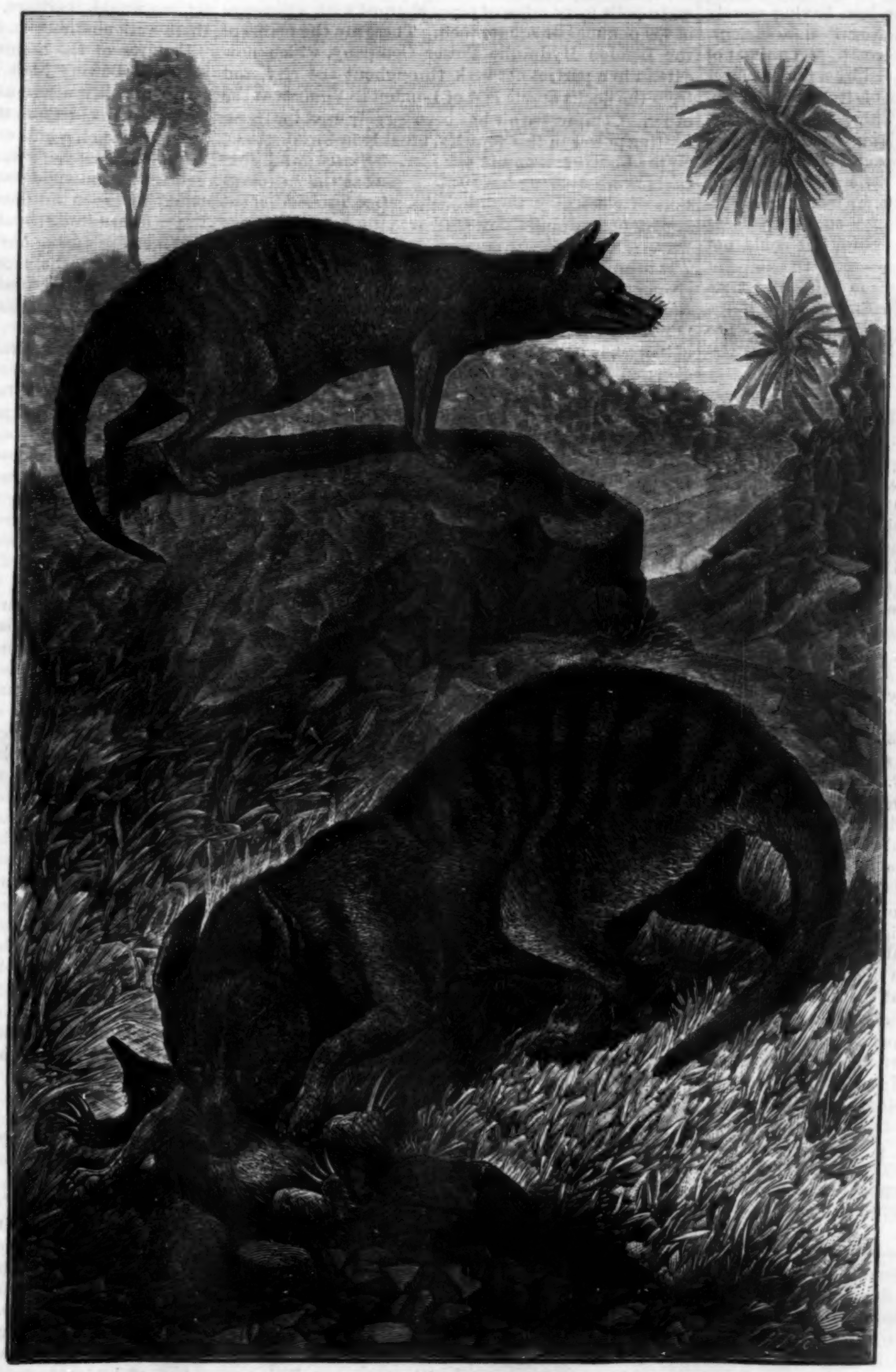
THE DOG-HEADED OPOSSUM.

Australia, Van Diemen's Land or Tasmania, and we may say New Guinea also, possess a population of mammals whose characters are so marked that it may be asserted that all these countries once formed a vast continent which has for a long time been separated from the other regions of the globe. The mammals of this southern, and now dismembered, continent belong, in fact, to other categories than the present mammals of Europe. They correspond to the order (or, better, to the sub-class) of Monotremata, comprising the ant-eaters and duck-bills, whose analogues might be sought for in vain in other countries, or to the order of Marsupialia, which still comprises, it is true, a few representatives in the new world, but which, since the tertiary period, has become completely foreign to our country.

Without being as odd as the Monotremata, which have retained certain traits of the reptiles and birds in their structure and mode of development, the Marsupialia yet present one strange character which stamps their organization with the seal of inferiority. Their young are born in such a state of feebleness that they would infallibly be condemned to perish had not nature taken care to protect them during the early period of their existence by offering them shelter in a pouch, or at least a cutaneous fold situated under the mother's abdomen, in the immediate vicinity of the hind legs. This pouch or *marsupium*, to which the order owes its name, is supported by two more or less developed osseous appendages which, according to several authors, result from the conversion into solid pieces of the tendons of the great oblique muscles inserted on the pelvis. During the entire period of nursing it holds the young in immediate and continual contact with their mother, and, later on, serves them as a place of refuge when danger threatens them. This, however, is not the only peculiarity of organization that the marsupials exhibit, for distinctive signs might also be easily found in the conformation of the feet, in the development of the clavicle, and in the arrangement of the lower jaw. On the contrary, the brain, the dentition, and the digestive apparatus do not furnish good characters, for they are not constructed upon a uniform type. Indeed, in the marsupials, they exhibit variations analogous to those observed in ordinary mammals, and that are in direct relation with the degree of intelligence, nature, and habits. Thus, while in the giant kangaroo the cerebral hemispheres are voluminous and contain many folds, in the sarcophile, which belongs to the same order, the encephalus is greatly reduced and the brain entirely smooth; and, while the same kangaroo resembles the tapir in the form of its molar teeth, the wombat recalls the rodents in its jaws, deprived of canines, but possessing strong incisors.

The differences are no less striking in the external form and in the proportions of the various parts of the body, and it is positively necessary to examine closely in order to discover the bonds of parentage between the little petauristes and the belides, which have the bushy tail of the squirrel and the alar membranes of a polatouche, and the great kangaroo whose pyramidal body rests upon a sort of tripod formed of a massive tail and hind legs two or three times larger than the fore legs.

So great is the diversity that we find among the marsupials that one might even be tempted to establish a system of parallel classifications for these animals and the ordinary mammals. But one would very quickly find himself arrested by a certain number of important gaps, for, among the present marsupials, there exist no types comparable to the bats, seals, elephants, horses, etc. On the contrary, it is certain that the kangaroos, now so common in zoological gardens, have exactly the nature of our herbivora, that the phascolomes (wombats) may be compared to our marmots, whose bulky form, massive head, and digging habits they possess, while the dasyures, sarcophiles, and thylacines, which in Tasmania and Australia play the part of our carnivora, seem to have borrowed the gait and even the color of some of these animals. The dasyures, for example, have the stature, pointed nose, and spotted fur of the genets, and, like them, feed upon small mammals, birds, and insects, which they capture after sunset. As regards external form and nature, there are the same resemblances between the wolves of our country and the thylacines of Tasmania, to which we propose more especially to call the attention of our readers.



THE DOG-HEADED OPOSSUM (THYLACINUS CYNOCEPHALUS).

The thylacines, of which we know but a single species (*Thylacinus cynocephalus*), are found, at the present epoch, probably confined to Van Diemen's Land, where they are destined to be exterminated in a near future, as the wolves have been in England. After having been distributed over the entire country, they have gradually been driven into the interior by the colonists, whose herds they decimated, and have been obliged to seek a refuge upon mountains of from 3,000 to 4,500 feet altitude, in regions where snow falls during a part of the year. It is here that it was necessary to look for the thylacines that were taken to London about 1850, and those that have been living for three years in the Garden of Plants, and from which the figures were made that we herewith publish. As may be judged from these faithful portraits, the thylacines have exactly the physiognomy of the wolf in their conical head, erect ears, and elongated snout truncated at the extremity. They have also the formidable dentition of the wolf, the numerous incisors and the sharp molars, although the latter do not offer the same proportions. The body is more slender and sits lower on the legs, and the tail is much more tapering, more woolly, and colored entirely differently. The coat of the thylacines, in fact, is of a brownish-gray, variegated with yellow, which becomes lighter toward the lower parts of the body, and which upon the loins is crossed by fourteen dark stripes. These stripes, which are very sharply outlined, recall those of the ichneumons, and increase in length up to the hips, where they fork and are continued upon the base of the tail by three or four similar but much shorter stripes. The tail, which is provided with coarse hairs, is of a dark brown above, of a lighter shade beneath, and blackish at the extremity. The head is of a pale shade, but a dark line extends on each side through the eye, at the angle of which there is a tawny spot, and the muzzle is of a dark color, with a little white on the edge of the upper lip. The latter is provided with long mustaches, and, as in the dog, a few hairs are implanted in the cheeks and over the eyes, which latter are large and have a dark chestnut-brown ball.

To complete this description, let us say farther that in the thylacines the marsupial character is scarcely indicated, the bones designed to support the ventral pouch being rudimentary. It is not astonishing, then, that the first colonists took these animals for genuine wolves, and the less so in that, although the proportions differ, the size is about the same in the two animals. This explains why the common name zebra wolf was given to the thylacine concurrently with the names tiger, hyena, zebra opossum, and dog-headed opossum. The thylacines hunt the kangaroos and bandicoots, and also attack the echidnas, which they succeed in strangling and devouring despite the spines that constitute the defensive armor of these singular mammals. It is even asserted that formerly, while they were as yet wandering upon the seashore, they fed greedily upon the remains of seals, decayed fish and mollusks cast up by the waves, but the settling of European colonists in Tasmania furnished the indigenous carnivora with a more succulent food. In fact, the colonists introduced domestic animals upon the island and devoted themselves to the raising of cattle and poultry upon a large scale, so that the thylacines easily found the wherewithal to satisfy their sanguinary appetites, and so much the more easily in that in their quality of nocturnal animals they could profit by the darkness to slaughter sheep in the folds and fowl in the poultry yards. In order to defend their property against such terrible enemies, the farmers had to display all their vigilance and energy, and it was not without great trouble that they succeeded in driving the animals to the mountains. It was especially by setting traps for them that success was obtained in arresting their multiplication, for although the thylacines dare not attack men, they show a bold front to the dog, which hesitates to attack them, and which retires from the contest defeated and crippled.

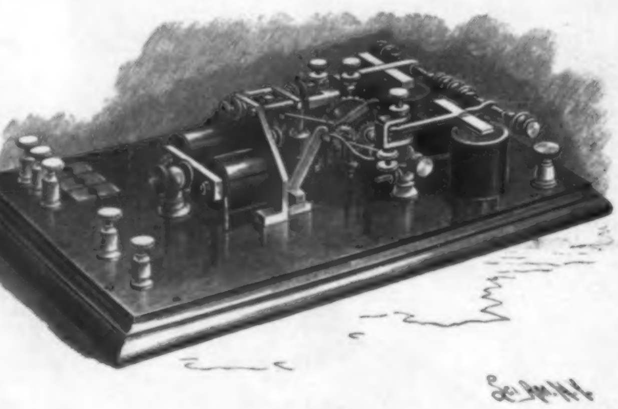
Up to the present, the thylacines have not bred in captivity, either in France or England. Those in the Garden of Plants seem to have become accustomed to the loss of their liberty, and do not exhibit any more ferocity than do many other carnivora, and, as in their native country, they prefer to remain hidden during a portion of the day.

We have said above that the thylacine was probably confined to Tasmania. The reason that we were not more affirmative was that we remembered that on two occasions the Zoological Society of London has received information that tends to make us believe in

the existence in Australia of a carnivorous marsupial more or less analogous, if not identical, with the thylacine. In a letter addressed to Mr. Sclater, Mr. B. G. Sheridan, of Cadwell (Queensland), states, in fact, that his son, a boy of thirteen, who was accustomed to run the woods like an old hunter, was out one day accompanied by a small terrier, when he saw the latter obtain a scent and follow it up with eagerness. Curious to know what game he had to do with, the boy ran after his dog, and found himself face to face with an animal of the size of a dingo dog, with a round head like that of a cat, with a long tail, and with a body striped with yellow and black, and which was crouching in the high grass at about a mile from the coast. The dog and the savage beast soon grappled, and the boy, in order to aid his companion, tried to kill the enemy with a pistol shot, but, having merely succeeded in wounding and rendering it more furious, he judged it prudent to beat a retreat. An animal of the same species was also perceived by a police officer of the same district, and traces of it have been observed on several occasions. Thus, in 1872, a Mr. Hull, having been called by his inspection service to the banks of the rivers Murray and Mackay, to the north of Cadwell, was taking a little rest in his tent, when, in the stillness of the night, he heard the barking of an unknown animal. He at once started out with his companions, armed with guns, but could not see the beast. In return, he discovered the imprint of its feet upon the ground, and made a faithful tracing of the same, which he sent to England through a Mr. Scott. Now this imprint seems to conform well to the track of a carnivorous animal of the size of a thylacine.—*E. Oustalet in La Nature.*

AN IMPROVED ELECTRIC SIGNAL.

The accompanying illustration represents a signaling apparatus for use in connection with telegraph lines, by which a signal may be sent to any station upon the line without disturbing the other stations. It is designed to place all the signals upon the line under the control of the train dispatcher, whereby he can signal a train at any station, whether the operator at that station is asleep or awake, present at his instrument or absent. The invention has been patented by Mr. John D. Taylor, of Piketon, Ohio. The principle of the apparatus may, perhaps, be best explained by supposing that the several stations on the line will each be indicated by a letter of the Morse alphabet, although any other system of dots and dashes might be employed. The call, therefore, for station "G," according to the Morse alphabet, would be two dashes and a dot (— — -). The several impulses of this call, operating through the line relay, and through magnets, gear, and ratchet wheels, move a wheel on the periphery of which are notches corresponding to the signal, on the completion of which another battery is automatically brought into circuit to operate a signal which may be a bell in the office, a semaphore at the side of the track, or other suitable device, the circuit last made by the call remaining closed until the operator comes to answer the signal, and, by moving a lever, allow the parts to return to the point of starting. The arrangement is such that any other letter or combination of letters than that for which the instrument is adjusted would prove inoperative to work the signal. This instrument is also designed for use wherever a number of electrical instruments are connected in series, and where it may be desired to throw one of the instruments into the circuit without affecting the others.



TAYLOR'S ELECTRIC SIGNAL.

A Wise Father's Good Counsel.

"Hundreds of young men of fine natural ability and thorough education make miserable failures in life merely because they have rich parents," said one of the oldest and most successful iron merchants in St. Louis to *Stoves and Hardware.* "If they were thrown upon their own resources from the start, many of them would not only succeed in a monetary sense, but would become worthy and influential citizens. As it is, the majority fail, simply because they lack incentive. Over thirty years ago I started in business with scarcely any capital, but with plenty of courage and energy, and a firm resolution to accumulate enough to place my family in comfort in my old age. Never allowing myself to forget this object for a moment, I have succeeded beyond my most sanguine hopes. Now I have a son who recently graduated at a prominent institution of learning. Instead of selecting a profession he looks forward to a life of activity in a mercantile pursuit, and has commenced work as an assistant shipping clerk in my establishment. The work is hard and the pay small, but as he masters the business he will advance. After a while he will earn his way through the various departments to a desk in the counting room. It may take several years, but the practical knowledge thus gained is essential to a successful business career, and, besides, it is a knowledge obtained only by such work. Of course I could have placed him in the counting room at first at a good salary, but this would not have given him the necessary experience, nor have enabled him to obtain the independence and self-reliance that comes with a thorough mastery of business. In the years to come that boy will have a knowledge of business that will always find him employment should financial reverses come. But, as a rule, financial reverses never come to men with such a training. If rich fathers would encourage their sons to work through such an experience, they would see the day when their sons would bless them for it. Idleness will ruin any young man."

The Distribution of Hydraulic Power in London.

Few Londoners (writes a correspondent of the *Times*) are aware that there are now under the streets of the metropolis forty miles of pipes charged with a pressure of 750 pounds per square inch. These are the mains of the London Hydraulic Power Company, which now extend in a perfect network throughout the city, and from the docks at one end of London to Victoria at the other. Compressed air has been largely used for transmitting power in this country, notably in Birmingham, on the Continent, and in the United States; and electricians are working hard with a view to the introduction of electricity as the agent. But in London the system of hydraulic power is virtually having its own way.

It is now more than half a century since Lord Armstrong first directed his attention to the utilization of water pressure and its transmission for mechanical purposes. For the past thirty or forty years hydraulic machinery has been in use at docks, at railway goods stations, in warehouses, and elsewhere. But Lord Armstrong's enthusiasm led him to anticipate the time when the practice would be widely extended, when hydraulic power would be drawn from a common center, especially for fluctuating and intermittent purposes. That dream has been realized. By the system which was established at Hull, in 1876, under the direction of Mr. E. B. Ellington, by the system which has been organized in London by the same engineer, and by a similar undertaking at Liverpool, a service of high pressure hydraulic power is now at the command of the public, of consumers large and small, the cost of the power being in direct proportion to the work done.

The mains in London are of cast iron, varying in internal diameter from 7 inches to 2 inches, and are kept charged constantly at a pressure of 750 pounds per square inch by powerful engines located at Blackfriars and Westminster. The engines at the Blackfriars station can pump 3,000,000 gallons per week, and those at Westminster 2,000,000 gallons; and the rapidly increasing demand for power has necessitated the construction of a pumping station at Wapping which will deliver 4,000,000 gallons per week. The present supply to consumers amounts to about 3,750,000 gallons weekly. This is consumed by somewhat over a thousand machines, and there are at the present time 200 applicants for machines to be connected with the mains. This power is supplied direct to lifts, presses, and other purposes of a similar character without the use of any engine or power-producing machinery, and can also be used for driving engines of special construction in the same way as steam or gas. Many such engines are now at work grinding coffee, ventilating, working elevators and crushers, driving dynamos and general machinery, but hydraulic power is chiefly used for machinery which is used intermittently. For pumping it is also valuable. No engine is required, only small direct-acting rams, which may be allowed to run without attention. The quantity of power used is measured in gallons by meters, and is charged for on a sliding scale, commencing with a minimum of £1 10s. per quarter for 3,000 gallons or under, down to about 2s. per 1,000 gallons in the case of large consumers. The power is available day and night and on Sundays all the year round. There it is, to be had by the simple turning of a tap. There is no getting up of steam, no filling of tanks for one's own hydraulic supply.

As has been indicated, it is where power is required intermittently that it is cheaper to use hydraulic power than to set up one's own gas or steam engine. The engineer of the company considers that, taking all the circumstances into account, it can hardly be a profitable operation to supply public power under conditions similar to those which exist in London at less that 2d. per indicated horse power per hour. This would be from £20 to £25 per horse power per annum, working from fifty to sixty hours per week. Where the power used is small, that would compare favorably with the cost of steam. The comparison may not, perhaps, be so favorable with a gas engine working under the most advantageous conditions; but directly the gas engine is set to do intermittent work, the advantage is largely on the side of hydraulic power; while for such purposes as lifting and pressing, the general convenience and simplicity of the hydraulic system, are such that its use would, perhaps, scarcely be affected even if there were no direct economy in the cost of working.

Failures of the mains occur occasionally, and, considering the very high pressure with which they are charged, this is a serious matter. The velocity of water at 700 pounds pressure through a free orifice being 330 feet per second, a hole only a quarter of an inch in diameter will pass between 30,000 and 40,000 gallons in 24 hours. The method employed for detecting leakage is based upon an automatic record of the quantity of water forced into the mains. When there is an abnormal increase during any night, particularly during the early hours of the morning, the mains are tested. Pressure gauges of considerable range are connected to each of the mains radiating from a station. Each main is shut off in succession, and the behavior of the hands of the gauge will indicate whether there is leakage or not. By closing in succession the valves along a main in which a leak has been discovered, and by using a sounding rod, nearly the exact spot of the leakage may be determined. On one occasion, from the record of the pumping, a leak was supposed to exist in one of the mains running from the Blackfriars station. An observation was made, and the action of the gauge could only be accounted for by a stop valve about two miles away, supposed to be closed, passing a small quantity of water, and by a machine near the valve having been left working by an attendant. Upon examination at the spot the valve was found leaking, as had been expected, and the machine could be distinctly heard at work. It was a small hydraulic pump, and each stroke was indicated by the gauge.

One important use of this high pressure water circulation has not been indicated—namely, its use in case of fire. A small jet f high pressure water injected into a larger jet from the ordinary waterworks mains so intensifies the pressure of the latter in the delivery hose that a jet of great power can be obtained at the top of a high building without the aid of a fire engine. Captain Shaw has expressed a very decided opinion as to the value of this high pressure supply of water for the extinction of fire, but though the provision of the necessary injector hydrant is comparatively inexpensive, the authorities have displayed an apathy on the subject which is difficult to understand. Last year Captain Shaw witnessed a most satisfactory experiment. The jet from an ordinary water main, having a pressure of about 40 pounds per square inch, rose through a hose to a height of 40 feet or 50 feet. The high pressure water was then turned on through a three-eighth inch opening. The jet at once rose to a height of 90 feet or 100 feet, which, in the opinion of Captain Shaw, would have been as useful as any fire engine for extinguishing a fire. It has been stated that in Manchester, after the introduction of high pressure hydrants, the loss from fire was reduced by six-sevenths. In Liverpool the loss was reduced to one-fourth of what it was previously. If the annual loss from fire in London amounts, as is calculated, to over £2,000,000, and if the saving effected by an efficient system of hydrants were only one-fourth, or even one-tenth of the saving effected in the cities mentioned, it would amount to hundreds of thousands of pounds annually.

"I ALWAYS make it a point," remarked a manufacturer, the other day, "to reply to every communication of a business nature addressed to me. It doesn't matter what it is about, provided only that it is couched in civil language. I do this because courtesy requires that I should; but aside from that, I find also that it is good policy. Time and again in my life I have been reminded by newly secured customers that I was remembered through correspondence opened with me years before, and many orders have come to me through this passing and friendly acquaintance with people. On the other hand, I have known plenty of business men whose disrespectful treatment of correspondents has been bitterly remembered and repaid with compound interest. Silence is the meanest and most contemptuous way of treating anybody who wishes to be heard and to hear, and resentment is its answer every time."—*Age of Steel.*

SOME EFFECTS OF LARGE CURRENTS.

BY GEO. M. HOPKINS.

During some of the earlier experiments with electricity as a motive power for railways, in which the rails were employed as conductors of the current, it was observed that the wheels which received the current from the rails had an enormously increased traction while the current passed. This was at first attributed to the direct action of the current, then to molecular change caused by the electrical heating of the surfaces in contact, but the phenomenon has never been fully explained.

The contact between the wheel and the rail under the conditions of actual use upon railways is scarcely more than a short line. If the surfaces were perfect as well as infinitely hard and rigid, the contact would be simply a mathematical line. In reality the surfaces in contact are very small, so that any current meeting the resistance of such a contact must produce some heat, which becomes greater as the current is increased. Experiments show that a current of several amperes, having a pressure of one volt or less, is required to secure good results.

Some interesting facts in regard to the local effects of large currents may be demonstrated by means of the simple apparatus shown in Fig. 1, in which a long pivoted index carries a jaw for holding a metal plate, *a*, the edge of which rests at right angles upon the edge of a metal plate, *b*, held by the fixed jaw. The free end of the index extends partly over the face of a scale secured to the base of the instrument. The two jaws are insulated from each other and connected by wires with a secondary battery or other source of electricity capable of supplying a six or eight ampere current with a pressure of from one to two volts. When this current passes through the metal plates held by the jaws, the parts in contact expand instantly, as shown by the upward movement of the index; and when the current ceases, the plates immediately contract, allowing the index to drop. Although the distance through which the index moves is small, it is measurable, and when the minuteness of the portion of the metal actually expanded is considered, it is seen that the expansion is very great. Different metals are not all affected in the same degree. As would be expected, the effect of the same current on good conductors, such as silver and copper, is less than it is on iron and German silver.

The molecular changes effected in the metals are analogous to those produced in the lead of the Trevelyan rocker. In this instrument, however, the expansion takes place in one only of the pieces of metal in contact, the other piece being contracted by the withdrawal of the heat by the cold metal.

The form of Trevelyan rocker shown in Figs. 2 and 4 has been designed with special reference to the comparison of the effects of heat from an external source, and heat generated within the metal by the passage of a current through a point of resistance. The clamps mounted upon the upright metal rods are arranged for holding plates of different metals. The rocking bar, which rests upon the edges of these plates, is of cylindrical form. In the side of the bar, at one end, is formed a narrow groove leaving ridges which rest upon the edge of one of the metal plates. In Fig. 2, the dark plate is lead. The rocking bar, of brass, is provided with a light index to show the vibrations. When this bar is heated by means of a flame, and placed upon the edges of the metal plates, with the ridges in contact with the lead plate, it rocks violently, and if the index be removed, the rocker gives forth a musical note, which continues until the heat of the bar is reduced below the operative limit. This action is due to the local expansion of the lead by contact with the ridges of the heated bar and the subsequent rapid cooling of the lead on the separation of the surfaces. These operations occur with great rapidity; the two ridges alternating in the production of the effects.

If, after cooling the heated parts, a heavy current is passed through the standards, the plates, and the bar, the same vibratory motion is at once set up, and while, in the case of the Trevelyan rocker, lead seems to be the only metal available for one of the surfaces, in the electrical rocker the results are the same in kind, although different in degree, with all the metals and alloys tried thus far.

To render the movements clearly visible, a pendulum is applied as shown in Fig. 4. The ring at the upper end of the pendulum rod is provided with a set screw, which allows it to be shifted from one rocking bar to another. This arrangement also permits of placing the pendulum and bar in working position, without the necessity of leveling the base of the instrument. The current from one small cell of secondary battery or from two large bichromate cells connected in parallel circuit is sufficient to cause the pendulum to begin to oscillate from a state of rest, and to increase its amplitude of vibration until it describes an arc of about 30°. The heat generated by the current is conducted away so rapidly as to permit of continuous operation.

By raising the pendulum so as to bring the convex side of the rocking bar into contact with the edges of the plates, and drawing the bar along lengthwise of the plates, first without the current and afterward with the current flowing through the apparatus, a great increase in friction will be noticed as the current passes, the increased friction being due to the jutting out by expansion of points upon both the edges of the plates and the side of the rocking bar.

Fig. 1.—APPARATUS FOR SHOWING LOCAL EXPANSION.

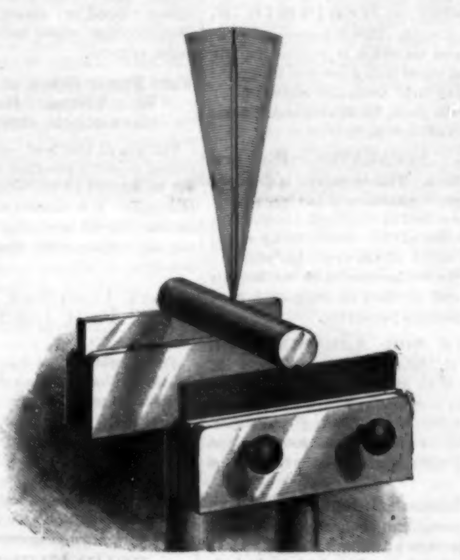


Fig. 2.—ROCKER FOR APPLIED HEAT.

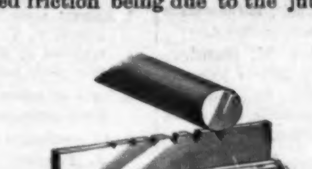


Fig. 3.—MODIFIED ROCKER.

In Fig. 3 is shown a slightly modified form of rocker in which a plate with a graduated series of notches is used in connection with a cylindrical bar.

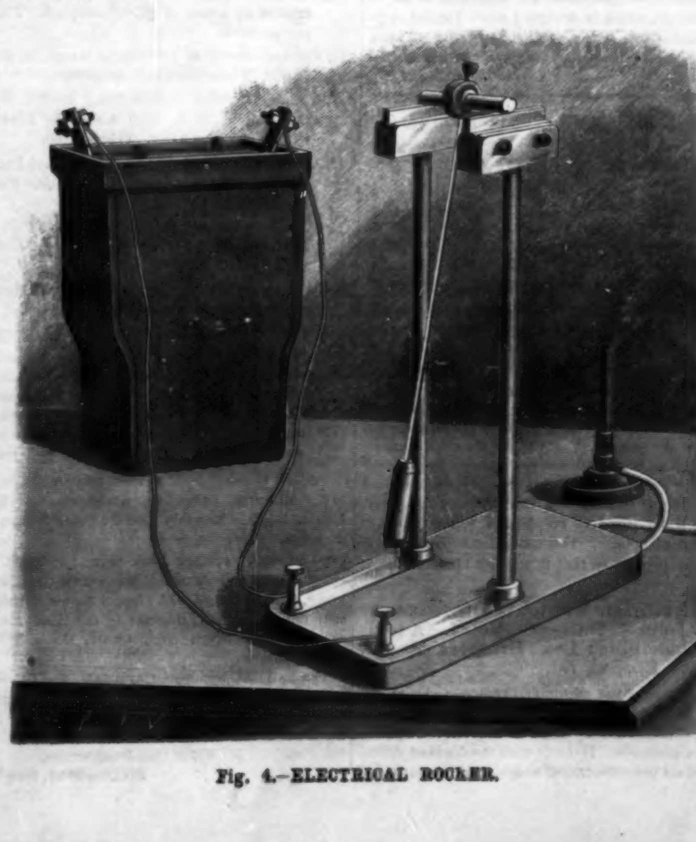


Fig. 4.—ELECTRICAL ROCKER.

In the case of the rocker with the attached pendulum the taps of the rocker upon the edge of the plate are as distinct and regular as the ticks of a French clock.

The Secret of Cheap Building.

A man who is resolved to be independent of landlords can build a very comfortable house for from $2,000 to $2,500. He can have sufficient room, and a house with a decent exterior and a plain interior. He ought, first and foremost, to provide a bath room, even if he cannot buy a slate mantel. It will be the wisest in the long run to have a bath room. Ask any woman who has had the care of two or three children how much a bath room saves them. The larger the family, the greater the saving in work and worry, which is more wearing than work. If a man has only $2,000 and a large family, he must sacrifice something or deny himself something when he builds.

If he is wise, he will contrive closets and cupboards, a style of house that renders running up and down stairs unnecessary (there is nothing so tiresome as going up and down stairs), make his dining room large enough for a living room, and see that the arrangement of the kitchen is labor saving. Slate roof, slate mantels, bay windows and pretty trimmings can all be dispensed with. There are people who do not seem to have any clear idea of the things that are appropriate in a cheap house. We recall an instance where a gentleman, after looking at a design for a cheap house, expressed surprise at the cost, which was very low, and in the same breath he inquired if the house would be roofed with slate. A cheap house is not roofed with slate, it is needless to add. His next query had reference to the plumbing. If his ideas were realized, the plumber would charge at least $300. Evidently, the gentleman thought the plumbing would cost about a third of that sum, or less.

To sum it all up, substantial fixtures rather than pretty trimmings. Good ventilation, ample room, plenty of light and warmth, may be obtained if a man desires to insure it in building for his own use, at a very moderate outlay. But then he must build to please himself instead of vying with his neighbor.—*Real Estate Record.*

Mineral Products of the United States.

Metallic Products of the United States in 1888.

Pig iron, spot value long tons, 6,489,738, $107,000,000; Silver, coining value troy ounces, 45,783,632, $59,195,000; gold, coining value, troy ounces, 1,604,927, $33,175,000; copper, value at New York, pounds, 231,270,622, $33,833,954; lead, value at New York, tons of 2,000 pounds, 180,555, $15,924,951; zinc, at New York, tons of 2,000 pounds, 55,903, $5,500,855; quicksilver, at San Francisco, flasks, 33,250, $1,413,125; nickel, at Philadelphia, pounds, 195,182, $115,518; aluminum, at Philadelphia, pounds, 19,000, $65,000; antimony, at San Francisco, tons of 2,000 pounds, 100, $20,000; platinum (crude), at New York, troy ounces, 500, $2,000; total, $256,245,403.

Non-Metallic Mineral Products of the United States.

Bituminous coal, tons of 2,240 pounds, 91,106,998, $122,497,341; anthracite, tons of 2,240 pounds, 41,624,610, $89,020,483; building stone, $25,500,000; lime, barrels, 49,087,000, $24,543,500; petroleum, barrels, 27,346,018, $24,598,559; natural gas, $22,662,128; cement, barrels, 6,253,095, $4,533,639; salt, barrels, 8,055,881, $4,377,204; limestone for iron flux, tons of 2,240 pounds, 5,438,000, $2,719,000; phosphate rock, long tons, 433,705, $1,951,673; zinc white, short tons, 20,000, $1,600,000; mineral waters, gallons sold, 9,628,568, $1,709,302; borax, pounds, 7,589,000, $455,340; gypsum, short tons, 96,000, $430,000; manganese ore, long tons, 25,500, $255,000; mineral paints, long tons, 24,000, $380,000; New Jersey marls, short tons, 600,000, $300,000; pyrites, long tons, 54,331, $167,658; flint, long tons, 30,000, $175,000; mica, pounds, 48,000, $70,000; corundum, short tons, 589, $91,620; sulphur, short tons, — —; precious stones, $64,850; gold quartz, souvenirs, jewelery, $75,000; crude barytes, long tons, 20,000, $110,000; bromine, pounds, 307,386, $95,290; feldspar, long tons, 8,700, $50,000; chrome iron ore, long tons, 1,500, $20,000; graphite, pounds, 400,000, $33,000; flourspar, short tons, 6,000, $30,000; slate ground, long tons, 2,500, $25,000; cobalt oxide, pounds, 12,266, $18,441; novaculite, pounds, 1,500,000, $18,000; asphaltum, short tons, 53,800, $331,500; asbestos, short tons, 100, $3,000; rutile, pounds, 1,000, $3,000; total, $328,914,528.

Résumé.

Metals, $256,245,403; mineral substances, $328,914,518; mineral products unspecified, $6,500,000; grand total, $591,659,931.—*Eng. and Min. Jour.*

No consideration is sufficient in law if it be illegal in nature.

RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING. — Thomas B. Winn, Darien, Ga. This is a device designed to render the common link and pin coupling automatic, and obviate all necessity for going between the cars to couple or uncouple them, the device being simple, strong and cheap, and easily attached.

CABLE RAILWAY.—George W. Higgins, Bunker Hill, Kansas. This invention consists of an automatic cover for the slot of a cable railway through which the grip shank passes, which will keep the slot covered along the entire length of track except immediately at the point where a car is passing.

Mechanical.

WATER MOTOR. —William E. Vernon, Sipe Springs, Texas. This invention provides for the transmission of the power generated by the revolution of two or more water wheels to a single driving shaft, the wheels being located in a frame forming a wheel channel, with hinged gates, and other novel features.

PLUMB LEVEL.—Carl E. Nielsen, Salt Lake City, Utah Ter. This is an instrument designed to supersede the ordinary fragile one, while being made at a low cost, and adapted to indicate true levels, straight plumbs, and correct compass lines in building, and also the angles in mining, and the height and distance of buildings and other objects.

PLANE. — Gustav Heymeier, Bremen, Germany. This is a tool for planing the bottoms of grooves in mouldings and ornamental woodwork, whereby the depth of the cavity may be readily fixed, and the shape of the curved bottom of the groove retained while the tool is doing its work.

VALVE. —Oscar F. Burton, Brooklyn, N. Y. This is a direct-acting graduating valve, with a bored body or case, in which is fitted a hollow stem for endwise movement, having at opposite ends valve heads of different areas, adapted to seat at opposite ends of the case, the valve being especially designed for use between supply and expanding chambers in working steam, water, gas, or other fluid.

Agricultural.

CHECK ROW PLANTER. — William R. Morse, Chicago, Ill. This invention provides a machine designed to be quickly and easily adjusted, while adapted to mark the ground oftener than is common with machines of this class, as a better guide to enable the attendant to control more closely the accuracy of the planting.

PLOW. — Franklin H. Wissler, Winchester, Va. This invention is designed to provide a simple construction of standard and point, whereby the point may be firmly secured in position and its securing bolts be in a great measure relieved of strain, the point being easily applied and removed.

Miscellaneous.

ANEMOSCOPE. — Cornele B. Adams, Walthourville, Ga. This is an instrument for making an accurate graphic record of the direction of the wind at any hour or minute of the day, and consists of a properly ruled web, web-advancing mechanism, and pointers or markers, with connections between the web mechanism and a vane.

CABINET FILE. — John Muhlhauser, Rochester, N. Y. This is a file in which a number of horizontal rigid panels are arranged in a pile in an open frame or casing to press upon and hold in compact position assorted sheet music, periodicals, etc., the panels having a hinged vertically sliding connection with the casing.

MUSIC ALBUM AND LEAF TURNER. — Warren H. Jen Devine, Friend, Neb. This invention covers a novel construction whereby the sheets of music held in the album may be turned by the performer at will by pressing against the knee swell of the piano or organ.

GAS STOVE. — James H. Carrington, New York City. This stove consists of a shell made in the shape of a cone or dome and formed of transparent material, preferably of different colors, to form a pleasing glow from the light visible through the foraminated or woven wire casing from all sides of the stove.

OIL STOVE OR LAMP. — William W. Batchelder, New York City. This stove or lamp has a burner designed to produce the largest possible surface of flame by causing the flame to burn in a zigzag, fluted, or ruffle shape, giving a flame surface much in excess of the area which the width of the wick would otherwise afford, and a maximum amount of light and heat from the quantity of oil burned.

WEB CUTTER FOR LINING MACHINES. —Arnold W. Schlichte, New York City. This is an attachment for use with a machine formerly patented by the same inventor, to provide for the automatic action of the web-severing mechanism, such mechanism in the old construction having been operated by hand.

HEAD CHECK LOOP.—John H. Rafferty, Worcester, Mass. This is a device adapted more especially to hold headcheck reins to the crown strap of a harness bridle, and adapted also for use as a driving rein loop, being intended as a simple, inexpensive, ornamental, and reliable loop of this character.

HARNESS PAD. — Willard A. Bates, Princeton, Me. This invention consists in inflexible housing pads, united flexible connection, and provided each with a rocker at or near its transverse center, whereby the rockers will act against the under side of the saddle pads, to enable the housing pads to rock in the direction of the ends of the saddle, making a pad which can be adjusted to fit any horse, and which will adjust itself so that the whole surface of the pad will bear evenly upon the horse.

BUILDING.—James W. Brook, Lynchburg, Va. Combined with the framing are roof sections hinged or pivoted together, one of the sections being hinged or pivoted at its outer edge to the framing, and the other section being movable at its outer edge to and from the hinged edge of the first section, with other novel features, the invention being applicable in the building of ice houses and other structures.

BABY CARRIAGE BRAKE.—George W. Dolby, Tremont, N. Y. This brake consists of a rope or chain adapted to be secured to the handles of the carriage, twin hooks for engaging the felly of the wheel, having a common shank, and secured to the rope or chain, and a spring interposed in the chain, the device effectually preventing the vehicle from moving far, even on an inclined surface.

SLEIGH KNEE. — Seth C. Doane, Stevens Point, Wis. Combined with the runner and the beam is a knee having a ball and socket joint which forms a connection with the runner, so as to permit a certain amount of motion of the runner while securing the requisite strength.

POULTRY COOP. — Robert Yoakum, Dallas, Texas. This a portable folding coop, more especially designed for the transportation of fowls to market by rail or boat, and is so constructed that the coops may be readily dismantled or knocked down for return to the owner in packed and folded bundles, while the parts may be easily cleaned.

MIXING LIQUIDS. — Benjamin F. Phelps, Kansas City, Kansas. This is a device consisting of a rocking frame on which is pivoted an arm carrying a cup held on top of each glass containing the liquid, a platform being held vertically adjustable on the arm and carrying the glass, for mixing and shaking liquids thoroughly and efficiently.

EVAPORATING APPARATUS.—Richard G. Peters, Manistee, Mich. This invention is designed to secure the continuous evaporation of salt brine under vacuum by a continuous feed of brine and a continuous discharge of salt precipitated, the vacuum being sealed by immersion of the outlet of the discharge pipe in a tank of brine, where the salt is received by the buckets of an endless carrier and elevated to dripping bins or to other means or appliances for drying.

APPARATUS FOR ABRADING AND POLISHING.—James H. Niland, Port Jervis, N. Y. This invention relates to machines for cutting and polishing glassware by a revolving wheel, and provides improved means for agitating the abrading and polishing material to prevent its settling in the reservoir, and for applying it evenly and frequently to the cutting and polishing tool.

HEMMER. — Isaac Schneer, New York City. This is a single seaming attachment for sewing machines, designed to produce a flat single seam, especially desirable for uniting the sleeve of a shirt to the body and the body to the bosom.

SLIDING SASHES. — Sidney R. Deacon, Los Angeles, Cal. This invention provides means whereby a sliding window sash may be swung within the room to facilitate its cleaning, there being combined with the sash an attached hinged bolt, in connection with certain devices used therewith.

FOLDING SEATS. — John M. Sander, Bloomsburg, Pa. This invention relates to hinges to be used on opera chairs, school desks, etc., providing therefor a hinge which will be noiseless, and at the time simple and durable in construction.

LOCK.—Georg St. Meyer, Felton, Pa. This is a reversible lock, designed, with but slight changes, to be readily used as a right or left hand lock, while it can also be used as an ordinary door latch, the invention covering various novel features and combinations of parts.

RIDGE AND HIP COVERING FOR ROOFS.—Thomas Toner and John E. Carroll, of No. 32 North Fifth Street, Philadelphia, Pa. This is a new article of manufacture consisting of a series of plates adapted to be easily and conveniently applied by the roofer, to prevent all leakage of roof water, and at the same time give an ornamental appearance to the building.

METALLIC SHINGLE. — The above inventors have also patented an improved form of metallic shingle, which is designed when applied to be securely interlocked and braced, and prevent all back water from passing on to the wood on which the shingles are laid.

NEW BOOKS AND PUBLICATIONS.

THE CONVERSATION METHOD FOR SPEAKING, READING, AND WRITING GERMAN. Intended for self-study or use in schools. By Edmond Gastineau, A.M. Ivison, Blakeman & Company, New York and Chicago. Pages xx, 534.

The Gastineau method of learning to speak languages is based as nearly as possible on the natural method. It is a development, of course, of the old Ollendorff system, but greatly perfected. Throughout a great part of the work the parallel systems are given, the English and German filling their respective columns, one being a literal translation of the other. Besides this, where deemed necessary, phonetic spelling is used to give the pronunciation of the German. A number of exercises in text and written hand, with vocabularies under different headings, are very valuable and are well adapted to carry out the object of the work. At its end some 70 pages are devoted to the grammar proper of the language. The Gastineau system has acquired such popularity that it vouches for the value of this work.

THE NATIONAL MEDICAL DICTIONARY. By John S. Billings. Vol. I. A to J. Philadelphia: Lea Brothers & Co. 1890. Pp. lvi, 731.

The eminence of the editor and compiler of the present work is the best voucher for its value. Its title sufficiently expresses its contents, which include everything relating to medicine. It opens with the doses of different medicines in apothecaries' weights and measures and by the metric system, notes on the antidotes to different poisons, systems of numbering spectacle glasses, dimensions of parts and organs of the human body and their weights, and Professor Atwater's tables of foods and dietaries. After these the dictionary proper begins. Its character is of an extensive nomenclature, but with comparatively short definitions. It is a work for strictly dictionary use, not of cyclopædic capacity. It will be a most valuable addition to any scientific library.

REPORT OF THE COMMISSIONER OF EDUCATION FOR THE YEAR 1887–88. Washington: Government Printing Office. 1889. Pp. xii, 1209.

This valuable report treats of the educational work of the United States, the history and present aspects of education, and all recent occurrences in that field. The discussion of questions relating to different public institutions, statistics of school systems, training of teachers, secondary and superior instruction, professional instruction, kindergartens, and manual training are all treated at length. It is so comprehensive that it does not lend itself to a report. It may truthfully be said that all interested in education will be certain to find something in their own department of value and interest in its pages. The statistics are very exhaustive, covering all the prominent institutions of the United States. Many familiar names appear among the institutions treated of; among others a description of the Pratt Institute, whose work has been illustrated in our pages, is given.

THE FIRST BOOK IN COLOR. By Stephen W. Tilton. Boston: Published by the author. 1889. Pp. 137. Price $1.

The title of this book expresses its field. It is intended to give a practical system of color study which can be applied to the artist's use by carrying out its principles. It is claimed that all natural colors can be imitated by the mixture of pigments. It is an interesting attempt to make abstract theory subservient to practice.

PRATT INSTITUTE RECORD. Published by Pratt Institute, Brooklyn, N. Y. Pp. 53.

This number of the Record of the Pratt Institute of Brooklyn discloses what the institute is doing, its needs and prospects. The president's address indicates his desires. The Thrift Association and financial aspects and probable success of its undertakings are given ample space. An excellent illustration of the institute is used as frontispiece. The Thrift Association, to which we have alluded, is a species of savings bank which is conducted in unison with the work of the institute.

Business and Personal.

The charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(1806) H. A. asks: What is added to paraffine in the manufacture of chewing gum, to cause it to become plastic? A. A very little olive oil and some glycerine are melted in with the wax. The glycerine, as a softening agent, must be regulated in amount by the temper of the original paraffine.

(1807) W. H. L. asks: 1. How to stain white spots in buffalo horns, so as to polish; the horns have white tips, and along the top are a gray or a brown, and we cannot get a good black polish on them. A. Treat the spots with a solution of nitrate of silver, and expose to the sun. The treatment may have to be repeated. 2. Please give receipt to polish the same. A. For several methods we refer you to our answer to query No. 1324 in a recent issue of this paper.

(1808) C. H. W. asks: 1. Whether cotton, when packed in bales and stowed in the hold of a ship, and free from grease or any other foreign substance, can ignite spontaneously without the aid of any outside agency. A. It is very improbable; pure cotton cannot be regarded as spontaneously inflammable. 2. To what is the fact of spontaneous combustion, as in the case of cotton, attributable? A. To the presence of bales whose contents have absorbed cotton seed oil. This has recently been pointed out in our columns as a source of danger.

(1809) G. T. W. writes: How can I restore the polish to a slab of black marble which has been roughened in spots by acid falling on it, but which has not penetrated much into the stone? A. Polishing is your only resource. Ground pumice may be followed by finely powdered marble and finally whiting, or any polishing agents of similar character may be used in the order of their fineness.

(1810) T. P. H. asks: 1. How to take the stains from a solution of blue vitriol out of cotton goods. A. Wash out thoroughly with soap, followed by ammonia. After this, if the stain is not entirely gone, soak in lemon juice. 2. How is it that if you bottle cider, place bottle in cold water, and let water come to a boil, the cider will not work, whereas if you simply bottle it and set it away, it will work? A. The heat kills the ferment, a low form of primitive organism, upon whose existence and presence the fermentation depends. 3. Will you please explain the Grenet battery? A. The sulphuric acid dissolves the zinc, hydrogen is liberated at the carbon surface, to be instantly oxidized, forming water at the expense of the oxygen of the chromium trioxide. The last is reduced to sesquioxide, and combines with the sulphuric acid. Another portion of the sulphuric acid combines with the potassium, and the potassium and chromium sulphates give chrome alum as they crystallize.

(1811) E. B. B. asks: By whom were playing cards invented, and about what time? A. It is unknown. The first record goes back to the days of Charles VI., of France, February 1, 1392, of which date a memorandum exists, to the effect that Jacquemin Grigonneur was paid 56 sols of Paris for three packs of cards (*jeux de cartes*). This proves that they were known at that date, but there is no clew to how long they had then been in use. There is no proof that they were invented for the amusement of this monarch, as is often stated.

(1812) M. M. M. writes: I know the stand you have always taken on the much worn question of perpetual motion, and, so far as I know, no one has been able to prove that your position is not the correct one. But suppose such motion should be produced pure and simple, and demonstrated beyond the possibility of doubt to the world, without the least mystery concerning its workings. Would it be valuable enough to warrant an outlay say of $50 or $100, either for exhibition or any other purpose? A. Yes.

(1813) S. S. W. asks: Is it cheaper to use a 40 horse power boiler when one 20 horse power can be made to do the work? Also how far will steam carry from 40 or 50 horse power boiler without condensing? A. There is economy in using the 40 horse power boiler where a 20 horse power boiler will do the work. The large proportional fire surface of the larger boiler absorbs the heat that would be lost in the waste heat of the smaller boiler, and thereby lessens the temperature of the waste products of combustion in the chimney. There need be no more grate surface in the large boiler than would be used under the small boiler. For this purpose the sides of the fire chamber can be bricked in on the grate to make the area of the proper size. Steam may be conveyed from 500 to 1,000 feet with good effect, where the pipe is full large to lessen friction, and thoroughly felted and boxed. There will always be a small amount of condensation under any condition. With a properly arranged steam plant there need be no more loss in pressure than from 7 to 12 pounds for above distances.

(1814) G. L. L. asks how to obtain water from a lake elevated 10 feet above land. I wish to irrigate, but a ridge knoll or hill lies between the said lake and the land to be irrigated, fully 40 feet high, distance 900 feet. The question is how to obtain or convey the lake water over the hills any plans or suggestion would be thankfully received. A. There is no royal road to convey the water over the ridge. If you cannot go around, nor through, there is but one way left, which is force, which may be in the form of a windmill for economy in running. As the pipe line would be a siphon, the work of the windmill would be comparatively light, by which a larger volume would be discharged than if pumping to a reservoir on the hill only. When you find how much water you will require at constant flow, address the makers of windmills advertised in SCIENTIFIC AMERICAN, for details as to size and cost of plant.

(1815) F. F. F. asks for a good receipt for making indelible ink for marking linens, that will be black and will not wash out. A. For formulas for inks we refer to our SUPPLEMENT, No. 157.

(1816) H. D. B. asks: Is the core of the telegraph magnet or any other made of iron or steel? A. Soft wrought iron. 2. Will it do to have them fastened to a piece of iron flat and not in U shape? If so, can any blacksmith make them (the cores and yoke piece)? A. Yes; if the cores and flat yoke piece are well fitted together. 3. Can you tell me how to make a battery strong enough to light three 4 candle power lights? A. See SCIENTIFIC AMERICAN, vol. 57, p. 116. 4. How to make a cheap powerful electric motor to run a lathe. What size wire to wind magnets with, and about how much the whole thing will cost? A. See SUPPLEMENT, No. 641.

(1817) J. A. C. says: We have built several stone cellars with sand and lime, and put two courses of brick on the bottom and two courses on the sides (the brick were laid in Portland cement); with all this precaution the cellars fill with water 2 feet and more whenever it rains. The water breaks in through the bottom and sides. How can we build water-tight cellars? A. The best way to make a waterproof cellar is, at the time of building, to spread over the cellar bottom a layer of cement made of the best Portland cement and clean sharp sand in equal parts. Let this layer extend beyond the exterior lines of the walls. Erect the walls on the cement, and as the walls go up, cover them upon the outside with an inch or two inches of the same cement, carefully joining it to the cement floor. This is the only effective way we know of to realize a perfectly waterproof cellar, and its success depends upon the excellence of the materials employed. The walls are in this way inclosed in cement, and the cellar is in fact a waterproof pocket; or lay an underground drain one foot or eighteen inches deep around the perimeter of the cellar.

(1818) H. C. B. asks: 1. What is the alternating, as distinguished from the continuous current? A. An alternating current consists of electric pulsations in opposite directions succeeding each other with great rapidity. 2. Can the simple electric motor be run with the alternating current? A. No. It requires a direct current. 3. Does it make any difference, provided you get the right amount of wire on an armature coil of simple electric motor, whether it is wound evenly or not? A. There is some loss in loose winding. It is best to wind as compactly as possible.

(1819) F. W. P. asks: 1. What will be the difference between the number of heat units expended in producing the hydrogen by dissociation of the gases of water and the number obtained and available for generating steam by reassociating them in the act of combustion? A. Theoretically none; practically a loss of 10 per cent upward will be the result. 2. How many atmospheres of pressure could be applied to hydrogen and it remain in its gaseous state? A. At ordinary temperatures there is no limit, as the critical temperature of hydrogen is very low.

(1820) A. Z. asks: 1. In an induction coil, how should the thin wire of the secondary coil be wound—in the same direction as the thick wire of the primary coil or in the opposite direction? The coil is to be used to give shocks. A. It may be wound in either direction. 2. Will 50 feet of No. 20 wire and 2 ounces No. 36 wire make a good coil? A. This coil would answer very well, but it would be better to use ¼ the length of No. 18 in lieu of the No. 20. 3. How should the ends of the wires of the primary coil be connected with a magnet and vibrator, so as to work well? A. Connect one terminal of the primary with one pole of the battery. Connect the other terminal with the post to which the vibrator is attached, and lastly connect the contact screw with the remaining pole of the battery.

(1821) C. H. M. asks: 1. Why are car wheels made to revolve with the axle and not on it? A. The leverage of the wheels over the bearings is less when the wheels are secured to the axles. This construction is better calculated to withstand lateral thrusts. 2. What is the action of car wheels on a track when the car is going round a curve? One must certainly cover more surface than the other, yet it does not revolve faster than the other. A. In going around curves the truck naturally tends toward the outside of the curve, and the wheels being coned, the larger part of the outer wheel rides upon the outer rail, while the smaller part of the inner wheel rides upon the inner rail, thus wholly or in part compensating for the different distances traveled by the two wheels. On some curves there will be more or less slip of one of the wheels, as often indicated by the singing of the wheels as they pass around the curve.

(1822) C. J. S. asks: 1. What is the best way to take the grease off the skin of sea fowl such as a loon? A. Sponge off carefully with benzine. 2. What is the best thing to take stains off white feathers, such as a yellow stain on white pigeon? A. It depends on what caused the stain; its treatment in any case is difficult, as any washing tends to impair the lay of the feathers. Alcohol or ammonia might prove efficacious. 3. Is there such a book as a furrier's manual? A. We think the Taxidermist's Manual, 50 cents, would be of use to you. The Text Book of Tanning, $4, we also recommend for treatment of leather in general.

(1823) H. W. M. says: 1. On artificial stone, made from Portland cement, there appears at certain times a white efflorescence which disfigures it. Would hydraulic pressure prevent this? Also would beach sand cause this? A. The efflorescence is due to impurities in the materials used, such as magnesian salts, either in the cement or sand, probably in the sand. There is no remedy. It will probably disappear in time. Hydraulic pressure probably would do no good.

(1824) G. D. asks if there is a good lasting cement that will cement rubber to cast iron that is turned off (not polished), for example a rubber band on cast iron wheel or pulley crown face. A. The following is recommended. Pulverized shellac is soaked in ten times its weight of strong alcohol. It forms a transparent mass that in three or four weeks becomes fluid without the addition of water.

(1825) J. E. S. asks: How are mirrors silvered? A. Mirrors are silvered thus: Tin foil is laid on a flat surface and mercury is poured over it. The clean glass is now pushed over the liquid amalgam, with its front edge below the surface. After pressure the glass is placed on edge until all the liquid drains away. Often true silver is deposited by chemical precipitation.

(1826) C. McE. says: On a wall of a large building in this city is an ivy that covers almost all of the wall. In the spring this ivy is filled with the birds, who annoy the people in the adjoining house. The sparrows seem to build their nests in the vine and then begin to sing at 4 A. M. every morning. Can't you help me? A. We are friends of the sparrows, for the good they have done us, and are unwilling to advise their destruction for the trifling offense of seeking a comfortable winter refuge. Their mating season is noisy, which should be borne with patience. When you are angry with the bird, think of the worm.

(1827) G. A. W. asks: Can you tell me how to renew a copying tablet after it has become soft and sticky? A. It can be remelted and cast over again, but the best plan is to make a new one, as described in our SUPPLEMENT, No. 438.

(1828) F. O. C. would like to know the ingredients of the lacquer used by electrical companies to cover telegraph instruments. A. The lacquer for instruments is made from clear shellac or seed lac dissolved in 95 per cent alcohol, 1 of lac to 12 or 15 parts alcohol, settle for a few days, decant, and color if desired with a little dragon's blood. Use very thin, and heat the articles to be lacquered to 160°. Lacquer quickly. The articles must be absolutely clear. A finger touch will impair the finish.

(1829) E. H. asks: Will you kindly give a formula for preparing "blue print" paper that will require but a short exposure to sun? A. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 584. 2. Will it work well on good linen writing paper? A. Yes.

(1830) W. S. R. writes: I have made two telephones as described in a late issue of the SCIENTIFIC AMERICAN, and they will not work. I have followed directions as near as possible with what I had to work with. 1. Does it make any difference which side of the permanent magnet is connected with the two pole pieces? A. No. 2. Will it work better with a return circuit in the ground than with a return wire? A. No. 3. Would No. 9 wire be too heavy to use on the line? A. No. 9 wire will answer, but it is heavier than is necessary. No. 12 is the usual size. You have failed in some particular in following the directions.

(1831) O. & B. write: We use a great many German mirrors in our business, and as they often come to us slightly scratched, so as to remove the silvering, we desire to know how we can repair the fault. A. It is considered impossible to effectively repair a scratched mirror. The backing on a fragment can be loosened by applying quicksilver and then can be placed over the crack, and tin foil (not lead foil) may be applied over all. Experiment will determine whether the method will answer your purpose.

(1832) T. B. S. writes: If, as is supposed, the sun is ninety-five millions of miles from the earth, can we see it with the naked eye? If not, what do we see? A. We see the sun itself. It is 860,000 miles in diameter. A 1 inch ball placed 9 feet from the eye is approximately to that short distance as the sun is to his distance from us.

(1833) A. T. O. asks: Will common wrought iron gas or water pipe turned off inside and outside so as to remove scale etc., answer for the cylinder of the Deprez galvanometer? A. The cylinder should be made of soft homogeneous iron. Gas pipe is apt to be defective.

(1834) J. R. C. says: Please give formula for anti-oxidizer to prevent gold and silver articles from discoloring during hard soldering. A. A wash of a paste of whiting and water dried on the bright parts of jewelry or silver ware will save it from oxidation while soldering, but must not interfere with the boraxed joint to be soldered.

(1835) W. R. C. writes: Will you inform me if a cemented cistern which has had the taste of the lime well soaked out would do for the storing of cider, if air could be kept from the same as in a barrel? A. We should hesitate to recommend it. As a preliminary measure we would suggest sponging down the sides with vinegar.

(1836) M. A. E. asks for a receipt for the lacquer used on chandeliers. A. The lacquer used on chandelier work is made of shellac and 95 per cent alcohol, very thin and slightly colored with dragon's blood to give it the orange color. The lacquer should stand a few days for the insoluble part of the gum to settle; the clear lacquer should then be poured off and filtered.

(1837) L. A. C. writes: 1. I have an electric bell similar to those used as an alarm or call bell on a Bell telephone. Does the bell require an alternating current to run it? A. Yes. 2. If so, how can I make a simple device, by means of which to run it by a common battery? A. You can operate the bell by the use of a battery and any form of pole changer. A magneto-electric machine, however, is more economical, as it will require a number of cells of battery to produce the current necessary to overcome the high resistance of the bell. 3. What is the office performed by the two permanent magnets, if they are such? A. The magnet polarizes both the magnet core and the armature. 4. Can power be transmitted electrically over a distance of thirteen miles? A. This can be done by placing a suitable dynamo at one end of the line and an electric motor at the opposite end.

(1838) G. G. asks: 1. Can an amateur make a home-made telegraph? A. Yes. 2. In the simple electric telephone spoken of in SCIENTIFIC AMERICAN, December 14, 1889, No. 24, can the magnet be broken in the middle, instead of one side, as shown, thus saving the expenditure of two magnets? A. Yes. 3. Can an amateur make a simple phonograph? A. Yes.

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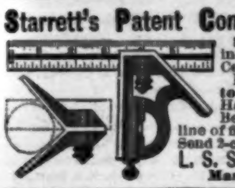

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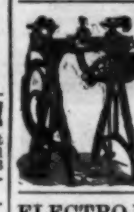

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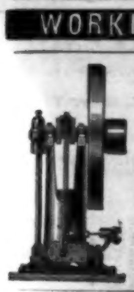

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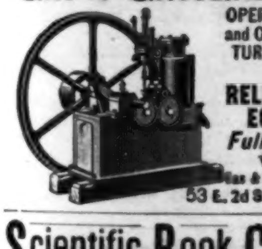

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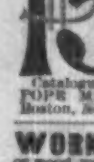

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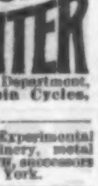

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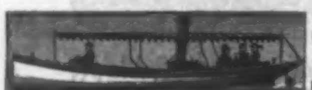

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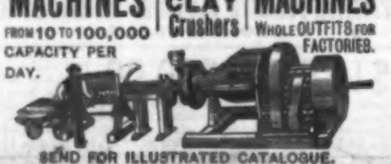

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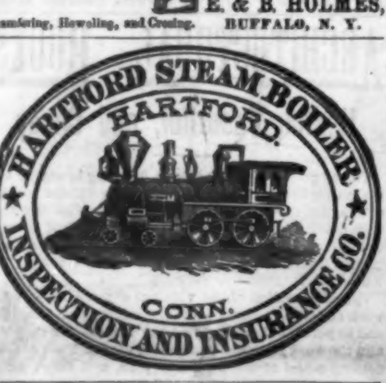

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